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QUARTERLY

OF THE

National Fire Protection Association

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87 MILK STREET, BOSTON, MASS.

EDITED BY THE SECRETARY

National Fire Protection Association.

87 Milk Street, Boston, Mass.

Active Members.

April 1, 1914.

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American Institute of Electrical Engineers.
American Institute of Mining Engineers.
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Western Canada Fire Underwriters' Association.
Western Factory Insurance Association.
Western Sprinklered Risk Association.
West Virginia Inspection Bureau.
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Wisconsin Inspection Bureau.
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Reports on fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

A Wired Glass Window Success.

Amoskeag Savings Bank Building, Manchester, N. H. On January 28, 1914, when the bank building was structurally complete, but while some interior work remained to be done, a fire broke out in an adjoining four-story building, which was occupied by a department store and was full of inflammable goods. The fire soon got beyond control and in the course of ten hours destroyed all the buildings on the block with the exception of the bank building, which not only was unharmed in itself, but also acted as an effective barrier against the spread of the conflagration to the remainder of the business district.

The wind drove the flames directly toward the bank building and for a number of hours they raged against the brick wall and wired glass windows. When the fire was finally controlled, it was found that while some of the wired glass panes were cracked, in no case was there any complete break or opening nor any damage to sash frames.

The Quarterly

Vol. 7 April, 1914 No. 4

The Eighteenth Annual Meeting. The coming Eighteenth Annual Meeting of the Association is set for May 5th, 6th and 7th in Chicago, a week earlier than last year. A special bulletin was issued by the Secretary on April 1st to emphasize the date and place, and the official program will be mailed as usual to members in advance of the meeting. The auditorium of the Insurance Exchange, generously placed at our disposal by our active member, the Chicago Board of Underwriters, is an admirable meeting room, being big enough to seat the attendance, yet small enough to enable speaking to be easily heard.

The members always enjoy the Chicago meetings, which usually call out a larger attendance than the meetings on the alternate years in New York; and the opportunity for the biennial visit to the testing station of the Underwriters' Laboratories is not willingly foregone. The attractions of Manager Merrill's hospitality and the educational opportunities incident to the visit to the wonderful big shop are no small factors in influencing the attendance of a number of prominent state and city officials who have said they are coming to the meeting this year. The addresses of Mr. Merrill, Dr. Stratton and President Chase of our new Chicago chapter will complete a big program, of which the most notable achievement, if consummated, will be the completion and adoption of the report of the Committee on Field Practice, which will give to the Association for publication an inspector's manual. The first report of the Committee on Safety to Life is also anticipated with much interest.

The prospective changes in the Articles of Association necessary to adapt them to the chapter organizations, and the recommendation by the Committee on Revision that the name "National" be changed to "American" may evoke interesting discussions.

* * * * *

Fireproofing Wood. The executives of the N. F. P. A. are favorably disposed to the appointment of a committee to investigate the subject of the fire retardant treatment of wood. The general condemnation of wooden shingles, wooden window frames and the use of wood trim in otherwise fire-resistive buildings has, according to the lumber interests, extended to such uses of wood as are wholly legitimate. There

is obviously no unreasonable prejudice in the ranks of the N. F. P. A. against proper uses of wood. New York is perhaps, the only city in the country that requires fireproofed wood in building construction, and it is doubtful if there has been sufficient gain in the fireproofing of wood to justify the additional cost. It may be that hard-wood trim, untreated, in buildings to the limited extent to which it is now being used, is practically as safe as the fireproofed trim.

The other use to which fireproofed wood is put in New York's fireproof buildings is for the flooring. Here again it is doubtful whether there is much gain in fireproofing the flooring, provided the flooring is properly filled up on the under side to avoid open spaces. Experience seems to indicate that the fireproofing of wood flooring gradually loses whatever value it has by the constant washing of the floors. The salts which are used in the fireproofing process are deliquescent, and when the flooring is first installed keep the floors quite damp. The use of water on the same gradually tends to wash out these salts.

Consul-general John L. Griffiths sends the following note from London on this subject :—

Considerable attention has been given in the United Kingdom to the best method for fireproofing wood, especially in connection with railroad construction. The following is a description of a process which, it is claimed, has received the favorable consideration of the British Admiralty. The wood is placed in large iron cylinders, the doors of which are hermetically sealed. The wood is then subjected to a course of steaming, and under vacuum the air and moisture in the pores of the wood are removed and the sap vaporized. The fireproofing solution is thereafter run into the cylinders, and under pressure forced throughout the pores and fibers. Subsequently the water in the solution is evaporated in drying kilns, and the chemicals, in minute crystal form, are left embedded in the wood. When heat is applied these crystals expand to many times their original size, forming a glassy coating to the fibers of the wood which excludes the oxygen in the air. In time the heat causes the crystals to collapse, but further crystals in the wood immediately expand, and the same process of resistance against fire continues. The chemicals used are antiseptic and preservative, consisting chiefly of phosphate of ammonia. As a result of the treatment, the life of the wood is also lengthened, for the cause of decay (sap water) is eliminated. This process is claimed to be especially satisfactory, inasmuch as the material treated is not saturated with a solution of salt, nor are such chemicals used as tungstate of soda, sulphate of ammonia, sulphate of alumina, alum, etc., which invariably cause discoloration of the wood, corrosion of metals, destruction of fibers, and prevent satisfactory painting or polishing. After this treatment the wood can be worked, nailed, glued, painted, polished, etc., as though it had not been subjected to any special process. All kinds of timber can be treated.

* * * * *

Dry Rot in Construction Timber. One of our members, Mr. F. J. Hoxie, recently made an interesting address in Boston on the subject of dry rot in timber used in slow-burning construction, following certain experiments which had been made by him. He arranged an experiment to determine whether the rosin in long-leafed pine heart wood was an important factor in resistance to fungus. A cubic block of dense, fine-grained wood two inches on a side, containing eighteen

per cent rosin, was sawed in two across the grain, and half of it was boiled in benzole until practically all the rosin was removed. The solvent was driven off, and a piece of wood containing living dry rot fungus was placed between the two blocks. The whole was placed in a moist atmosphere, and the fungus allowed to grow for a year, at the end of which time a dense white growth had formed over each block. This growth was removed, the blocks dried and weighed. The specimen from which the rosin was removed had lost eight per cent, the other only two per cent. Neither showed the brown color characteristic of rotten wood until after they had been dried for some time.

Mr. Hoxie stated that dry rot fungus, though not as common as several other varieties, has a thermal death point less than 100 degrees F., so that the practical application in the case of these fungi is that they may be destroyed in many cases by use of the building heating system. A badly infected mill can be given a cure, or one can get good results if the heating is applied soon enough, but he mentioned that the cure is not likely to affect the growth of fungi in the ends of beams in the brick wall where the heat does not readily penetrate. His suggestion is that when there is any question as to the quality of the stock used in the building heat is worth trying, and should be done as soon as possible after the building is completed.

Several of the more common fungi, which destroy basement floors, fence posts and railway ties are capable of resisting temperature up to the boiling point of water. It appears also that these fungi have strands, sometimes several feet long, capable of traveling for some distance across masonry or metal from beam to beam. Diseases of timber, like diseases of men, have excited more interest in cure than in prevention. Prevention is by far the best procedure, and much work has been done along this line on railroad ties, telegraph poles, etc. Mr. Hoxie said, in part:—

Numerous antiseptic compounds have been suggested, creosote compounds and chloride of zinc being probably more commonly used than any others. Creosote, however, is objectionable in buildings owing to its black, greasy nature, its somewhat increased fire hazard and disagreeable smell. The kyanizing process of treating timber with corrosive sublimate solution has been used more or less frequently with good results. Although its cost, corrosive qualities and poisonous nature have probably operated to prevent its more general use, it appears to be well adapted to treatment of factory lumber. Chloride of lime appears to encourage the disease rather than remedy it.

The season for cutting timber seems to have only a secondary importance, but the dryness of the wood, whether the moisture be sap or rain water, is an important factor. Preserving timber under water prevents fungus growth while the material is in storage, as fungus cannot grow without an air supply. It may also have some benefit in dissolving from the outer parts of the wood where infection must start some of the nitrogenous constituents which serve as food for fungi. Further investigation is however needed along the line of the chemistry of seasoning and heart foundation.

Quick-growing timbers will continue to come into more general use owing to their more rapid reproduction. The author's experiments would indicate that hard pine, to be able reasonably to resist fungus in building construction, without antiseptic treatment, should contain about 10 per cent of rosin. Artificial saturation of wood with rosin has been tried without very satisfactory results, owing to the

lack of penetration. It should not absorb over 5 pounds of water per cubic foot in 24 hours at 70 degrees Fahr. from kiln dry conditions, and should weigh not less than 38 pounds per cubic foot kiln dry. These characteristics generally accompany fine-grained material, and with them fine-grained material is better than coarse grained, while without them the fine grain does not appear to be a saving quality.

* * * * *

Railway Locomotives as Fire Engines. Our member, Mr. C. B. Edwards, of the Mobile and Ohio Railroad Company, sends us an interesting note on the use of locomotives as fire engines by his company. Within the past year this company has equipped fifteen switch locomotives with fire fighting apparatus, feeling assured that such protection would soon justify the expense.

Mr. Edwards says:—

On March 22, 1914, the roof of our passenger depot at Artesia, Miss., was damaged by fire and fire was extinguished by fire protection from switch locomotives before it made much headway. I am advised by our agent at that point that the entire building would have been destroyed had it not been for the fire protection from a switch engine, as water connection at depot had been cut off and fire had made some headway when discovered. The damage in this case amounted to but $3.50. Had the passenger depot been destroyed, the lunch room building nearby would have, no doubt, also been destroyed. The passenger depot is valued at $3,500 and lunch room $2,000.

The above demonstrates the advantage of locomotive fire protection at points where there is no immediate city fire protection. As our Association has previously printed data in regard to railway locomotives as fire engines, I thought this would be of interest to members. While we insure our buildings, equipment, merchandise, etc., we feel that it is better to prevent a fire than to repair the consequent loss and we are taking every practical precaution to prevent fires along our railroad.

* * * * *

The Dangerous Revolving Door. One of our esteemed exchanges, *Northwest Insurance*, vigorously emphasizes the danger to life that resides in the so-called revolving door, the winter storm door of all large stores, factories, office buildings and many other structures. The editorial says:—

Wherever you find the revolving door, you find a building in which a large number of people are housed during the business hours of the day. As a speedy means of exit, the revolving door is simply useless. It is a case of people lining up, one by one, and taking their turn to pass out as the door spins around. So far, this has been a matter of daily expected and tolerated delay. But suppose there is a fire in some big factory, office building, or department store equipped with these revolving doors? What will happen if there is a rush with many people trying to get through the door at once to safety?

The answer is simple enough. The door is going to be jammed so that it cannot be operated. The people behind will be trapped unless they can escape through other exits. And with a maddened rush of pushing, fighting humanity as in every panic, it is hard to tell just how disastrous the result may be.

So far as we know, but one of the thousands of big concerns in the Northwest has taken this matter into consideration. And that is the Donaldson Company, of Minneapolis. By the mere pressing of an electric button, each revolving door with its casing may be lifted by electric power to the ceiling and the entire exit

cleared for the escape of a crowd. And this is as it ought to be. All honor to Mr. Donaldson for giving the matter forethought. But what's the matter with all the other fellows? It is a subject for serious consideration and immediate action by liability companies and building owners.

* * * * *

Delivered by Discipline. For thirty years the students of Wellesley College have been preparing for fire. Before daylight on a March morning it destroyed the largest building on the campus. The students have joked about the day fire drills, and have groaned about the night calls; but they have filed down the long halls in orderly lines, and out the main entrances in less than two minutes.

When the test came in the pitch dark of the small hours of that morning last month, there were no hysterics, no fainting girls. At the clang of the first fire gong 250 students, 50 instructors and 50 maids woke out of a sound sleep to find their rooms filled with smoke. According to their training, they shut the windows and transoms, turned on the lights, and stood in the hall until the second gong rang, ten seconds later, when, under the eye of the fire marshal, they marched downstairs, the upper floors leaving first.

The front exit was in flames, the line was turned, and the 350 women were outside the building in three minutes. The squad roll call developed the fact that eight persons were missing, and the fire captains hurried back to wake their respective charges.

It was a triumph of order and sanity, and, as Miss Pendleton, the president, said: "The obedience to the fire drill as a result of discipline was a credit to the college. Never before has there been such a fire, with similar conditions, without loss of life or injury to some one."

The college girl of to-day, along with her acquisition of learning and theories of independence, has also absorbed the lesson of subordination to discipline. This exhibition of sanity and coolness should be a source of pride and gratification not only to Wellesley College, but to the country.

Public Education.

President Kohn's address, delivered at the New York City Club luncheon on March 28th, of which a considerable portion is printed on another page, is an unusually concise yet comprehensive statement of the problems of fire prevention. Such an utterance from so prominent an architect well deserves the publicity that was given it in the press. The president is a convincing and persuasive public speaker, and sees his subject always from an interesting angle.

* * * * *

Mr. Powell Evans, one of our executives, who is Chairman of the fire waste committee of the Chamber of Commerce of the United States of America, presented a very able report on the subject of the fire waste at the annual convention of the Chamber of Commerce in Washington in February. His report recounted the work of the Philadelphia Fire Prevention Commission, of which he is Chairman, and urged that its example be followed in other cities of the country. Among other interesting matter in the report are the following paragraphs:—

It will be difficult to remedy national carelessness, indifference and ignorance on fire waste, even with all agencies working to this end throughout the country in unified concerted action, but if divided, progress will be still slower. The business men of every community together with the local government officials concerned and the insurance interests concerned should be in tri-partite organization in this work. There is no need nor room for a new agency in the matter if the above controlling factors come earnestly together—particularly in view of the fact that the National Fire Protection Association is now organizing municipal chapters throughout the country, inviting just such affiliations as our local membership in this work.

The report closed by suggesting the following resolution, which was unanimously adopted by the Convention:—

"RESOLVED, that the Executive Committee of the Chamber of Commerce of the United States of America be and is hereby empowered:—

"(*a*) To request and authorize the Fire Waste Committee to investigate the advisability of suggesting to constituent local members the basis on which they may become affiliated locally all over the country with the new Municipal Chapters of the National Fire Protection Association, and combine with them in organizing local work to investigate and control fire waste of life and property in their respective communities; and

"(*b*) To clothe said Fire Waste Committee with power to take such action if upon investigation it deems this course wise."

Our member, Mr. Henry J. Davies, representing our active member, the American Electric Railway Association on several of our important committees, has been taking an active part in Cleveland with Messrs. C. H. Patton, H. N. Staats, A. W. Neale and other of our members in focusing public attention upon the excellent report of the Committee on Public Safety of the Cleveland Chamber of Commerce on fire protection in the Cleveland public schools. An interview with Mr. Davies, given considerable publicity in the Cleveland press, contains the following forceful paragraphs:—

Automatic sprinklers ought to be placed in every one of the seventy-eight old school buildings referred to in the recommendations of the Chamber of Commerce.

There is no better known method of safguarding such buildings. If anything better should be discovered or invented, I should favor its adoption in place of the sprinklers, or in addition to them.

The recommendations of the chamber, in my judgment, do not go far enough. Every floor in the old buildings should be protected. To leave any of these buildings in such condition that a fire may result in the death or injury of a single child, or even in the destruction or serious damage of the building, when methods of preventing or quickly extinguishing such a fire are known, is inexcusable.

The suggestion of School Architect Barnum and Dr. Ashmun that automatic sprinklers will not prevent smoke and that smoke may cause a panic is no objection whatever to the equipment of the buildings with apparatus that will automatically extinguish fires in their incipiency.

The sooner a fire is extinguished, the less smoke there will be. And the less smoke there is, the smaller will be the chances of a panic. Water does not create smoke. Neither does it send it skyward, or roofward.

Anything short of the best-known means of fire prevention and extinguishment will be insufficient, inadvisable and unjustifiable. A saving of money in this direction will be false economy, and should be condemned.

It is better to make mistakes on the side of safety than to refuse to put in the best form of protection. Extravagance along this line may be excused—forgiven—condoned—praised.

As chairman of the American Electric Railway Association's Committee on Fire Prevention and Insurance, I have for years urged the equipment of car houses and other traction buildings with automatic sprinklers, and millions of dollars have been spent by the street railway companies for this protection.

The companies have adopted the sprinkler system, not merely because of the possibility of a financial loss in property and business in case of the destruction of rolling stock by fire, but because also of the duty they owe the public to keep their cars in operation.

I have said to the street railway managers in conventions of the Association, that, in view of the present methods of protection, a $5,000 fire in an electric railway property would be a disgrace to any management, and that I should be willing to see it made a crime. I have the same feeling in regard to school buildings, except that the feeling is stronger because more human lives are in danger.

The report of the Committee on Public Safety is itself an exceedingly forceful document, classifying the construction of the numerous school buildings in Cleveland, and making recommendations for their safeguarding and for the protection of the lives of the pupils therein.

* * * * *

Our member, Mr. Frederick C. Moore, of Hartford, has recently delivered a number of interesting addresses on fire prevention inspections,

using for the purpose of illustration interesting lantern slides, giving views of characteristic building construction and structural faults. His lecture, delivered before the Insurance Society of New York in December, has been attractively published by that Society, and is interesting reading.

* * * * *

Mr. E. M. Underwood, of Portland, Ore., one of the directors of the National Association of Credit Men, delivered an address in January in Portland at the Eighth Annual Convention of the Oregon Retail Hardware and Implement Dealers' Association. The subject of his address was "Causes and Effects of Fires as Shown by the Camera." The lantern slides used in this lecture were prepared from photographs of hazardous conditions in Portland and elsewhere taken by Mr. Underwood himself, who is an indefatigable worker in the cause of fire prevention in Oregon.

* * * * *

The Chamber of Commerce of Columbus, Ohio, through its Fire Prevention Committee, has begun a most energetic campaign for fire prevention in Columbus. On Friday, February 6th, a luncheon was given at the Hotel Virginia, attended by both men and women, at which the fire prevention campaign was launched, with Secretary Wentworth of the N. F. P. A. as the speaker. The gentlemen of the Chamber having this campaign in charge are unusually capable, and salutary results are certain to be obtained. The creed of the Columbus Chamber is the celebrated historical oath of the Athenian, which is as follows:—

"We will never bring disgrace to this our city, by any act of dishonesty or cowardice, nor ever desert our suffering comrades in the ranks; we will fight for the ideals and sacred things of the city, both alone and with many; we will revere and obey the City's laws and do our best to incite a like respect and reverence in those above us who are prone to annul or to set them at naught; we will strive unceasingly to quicken the public's sense of civic duty; thus, in all these ways, we will transmit this city not only not less, but greater, better and more beautiful than it was transmitted to us."

* * * * *

The Committee on Municipal Research of the St. Paul Association of Commerce has issued an exceedingly interesting report on fire prevention in the city of St. Paul, of which the following comment on the fire alarm system is an extract. Copies of the report may be obtained by addressing the St. Paul Association of Commerce. Its perusal will undoubtedly be helpful to other similar bodies taking up fire prevention work.

The prompt sending of an alarm is a prime essential. The fire alarm system of St. Paul, situated in the basement of the Court House, is in a deplorable condition. Providence has been kind to us; we must gamble with Fate no longer. This apparatus should be surrounded with the best fireproof material; it is all cased in wood. The lockers once were burnt down three quarters, and a fire occurred in one of the cabinets. Waste paper is stored near it; two fires have already occurred here, and the next time may reach the alarm system. The "battery room," on which the whole system depends, is partitioned off by a matched board partition from a room used by the City Engineer and which is filled with lockers and junk.

If the partition should fall on the batteries as the result of a fire, the alarm system will be put out of business for fully 60 hours. The alarm wires are exposed to a steam pipe which has burst twice. Dampness also has nearly stopped the use of the delicate machinery.

* * * * *

Secretary Wentworth addressed interesting special meetings during the quarter at Bangor, Me., under the auspices of the Chamber of Commerce; at St. Johnsbury, Vt., under the auspices of the Commercial Club; at Camden, Me., at the annual banquet of the Camden Board of Trade, and at Bridgeport, Conn., at the annual banquet of the Bridgeport Board of Fire Underwriters.

* * * * *

The new Committee on Fire Prevention of the American Institute of Architects, composed of our three associate members—Julius Franke of New York, W. L. Plack of Philadelphia and J. Foster Warner of Rochester—has issued under date of March 30th an interesting circular to all members of the Institute, containing a number of interesting publications on the subject of fire prevention. Included in the mailing is an interesting little pamphlet containing general information on fire insurance requirements, with particular reference to fire prevention. This pamphlet, of inestimable value to the architect, was compiled by Mr. Julius Franke, in co-operation with the Chairman of our Executive Committee, Mr. F. J. T. Stewart, and is published jointly by the New York Chapter of the Institute and the New York Board of Fire Underwriters, which organizations generously supplied the executive office of the N. F. P. A. with a sufficient number of copies for mailing to our entire membership. The co-operation of the architects in fire prevention work, led by this devoted and energetic committee, must be considered one of our greatest assets at this period of our work.

* * * * *

Mr. F. E. Cabot, our Boston member, addressed the Board of Trade of Salem, Mass., on March 16th, on the subject of "common hazards and their neglect by municipalities." Mr. Cabot's forceful address made a very favorable impression upon the members of the Board of Trade, which is Salem's principal commercial organization.

* * * * *

One of our New Orleans members, Mr. Alonzo Church, has been doing a unique work in Louisiana, as evidenced by a copy of a local paper recently received. Mr. Church has interested the high school boys in several small cities to which his work calls him, and on several occasions has taken them with him on an inspection tour through the mercantile district of their cities. The live interest of boys of the high school age in objective things should make Mr. Church's fire prevention work with the younger generation exceedingly effective.

Vice President Frank M. Drake, Chairman of the Committee on State Fire Prevention Associations, reports that at the last session of the Kentucky Legislature his committee succeeded in securing the passing of a bill providing for the teaching of fire prevention in the public schools. It will be a relief to those who have ceased to look to the Kentucky Legislature for intelligent action to know that at least one legislative item was distinguished for sanity and good sense.

* * * * *

P. Blackiston's Son & Company, 1012 Walnut Street, Philadelphia, have issued a most attractive little booklet, by Major Chas. Lynch (price, 30 cents), entitled, *The American Red Cross Text-Book on First Aid.* It bears the special imprint, "Police and Firemen's edition." The object of this little book, as studied in the preface, is to furnish information on first aid to the injured, specially adapted to the needs of police and firemen, who are the first, in a large majority of cases, to be called upon when accidents happen, and who should therefore be carefully instructed in what to do and how to do it before the physician arrives. In certain classes of accidents, such as those occasioned by electric wires, poisoning by gas, drowning, etc., everything depends upon immediate and intelligent aid. Major Lynch has put his directions in a clear, concise manner, easy to understand.

It is a book which almost anyone would find valuable for home use, where accidents frequently occur, involving injury to children and others, which this little booklet indicates clearly how to treat.

* * * * *

We have recently mailed to our members a circular from Mr. Powell Evans, Chairman of the recent Philadelphia Fire Prevention Convention, setting forth the price and soliciting orders for the convention record already mentioned in these columns, and of which a synopsis was printed in the last issue of the QUARTERLY. The expense of getting out these books was greater than at first anticipated by Mr. Evans, but, as the circular will show, the price is still so low as to enable almost anyone interested in the proceedings of the convention to afford a copy.

* * * * *

Probably the largest audience which ever listened to an address on fire prevention assembled in the new casino at Bridgeport, Conn., Thursday evening, April 2d, following an earnest effort of the Bridgeport Business Men's Association to rouse the people to the necessity for action respecting a revision of the building code, the appointment of an electrical inspector and other important items. More than one thousand people were present to hear Secretary Wentworth's address, which, together with lantern slides and motion pictures, consumed nearly two hours. It was an exceedingly effective meeting, and the local newspapers gave it the attention which its importance deserved.

The Chapters.

Chicago.

The January meeting of Chicago chapter was made especially interesting by the presence of President Kohn, and Chairman Stewart of the N. F. P. A., and President Rudolph P. Miller of New York chapter, who were accompanying the industrial commission of New York on an inspection visit to the Underwriters' Laboratories. Chief McDonnell, of the Chicago Fire Prevention Bureau, was present with nearly a score of his uniformed inspectors, and there was a liberal representation of engineers, architects, manufacturers and insurance men.

President Chase of the chapter reported the following executive committee, which was elected: W. P. Dunn, chairman of the fire prevention committee of the Chicago Association of Commerce; W. H. Merrill, manager of the Underwriters' Laboratories; J. C. McDonnell, chief of the Chicago Fire Prevention Bureau; A. B. Pond, of Pond & Pond, architects, and T. R. Weddell, insurance editor of the *Chicago Record-Herald*. The executive committee was authorized to appoint the other committees of the organization. Mr. Kohn, who in addition to his presidency of the National Fire Protection Association, is also president of the New York City chapter of the American Institute of Architects, was the principal speaker of the evening.

He praised the plan of organizing the members of the National Association into these local chapters, that they might pay special attention to local needs and conditions. He held that defects of municipal government in America were largely due to the hesitation of the expert, the man who knows, to tell and use what he knows for the public good. People carried the idea of equality before the law to the extent of believing that anybody can do anything, and so incompetent men are put in charge of important public departments, which require a highly trained expert for the securing of proper results. Mr. Kohn said that the National Fire Protection Association reminded him of the parable of the talents.

The Association has a lot of talents—information and technical talents—which it has kept largely to itself. This was not intentional, but there was no way of spreading the information abroad and getting it known at the psychological moment, when it was specially needed. Most of the buildings criticised as fire hazards are put up by people who do not know anything about these underwriting standards, and who, if they did, would be glad to avail themselves of their help. The architects

were often hopelessly ignorant on this subject of fire prevention, as Mr. Kohn demonstrated by several examples. He suggested the publication of primer sheets to reach the builders and the general public with the essential principles of proper construction and of a standard fireproof building.

Rudolph P. Miller, superintendent of building for New York and president of the New York chapter, spoke briefly on its organization and policy, and the importance of impressing upon all the various lines of industry and commercial activity their share of interest in the problem of the fire waste. Such bodies could see that the various branches of the city government did their work properly, could look after local and state legislation, and could be specially helpful in developing public sentiment against the fire waste.

F. J. T. Stewart, chairman of the executive committee of the National Fire Protection Association, said that the country was now aroused on the problem of the fire waste and it was necessary to utilize and properly direct this interest, and teach the public how to correct the situation.

Report was made on the effort of the Association of Commerce to extend the fire limits of Chicago, and the opposition this was encountering from the lumber interests, with other discussions as to various features of the chapter's activities.

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New York.

The New York chapter met at the City Club on Monday evening, April 6, at which time the organization was completed and officers elected. There were addresses by J. O. Hammitt, of the New York City Fire Prevention Bureau, and Rudolph P. Miller, Superintendent of the New York City Building Department. Both addresses were on fire prevention topics, and that of Mr. Miller was illustrated by lantern pictures.

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Manitoba.

The Manitoba chapter with headquarters at Winnipeg has elected the following officers and committees: President, G. V. Hastings; vice president, E. A. Mott; second vice president, George N. Jackson; secretary and treasurer, H. R. Page. Executive committee: J. H. Ashdown, W. E. Fudger, W. S. Fallis, George W. Erb, W. H. Carter, J. H. Parkhill, W. P. Over, Russell M. McLeod, F. G. Taylor, Portage la Prairie; J. Cornell, Brandon; the provincial fire commissioner, Fire Chief Buchanan, the Winnipeg building inspector, the city electrician and the chairman of the City Council's Water and Light Committee. Membership Committee, C. S. Riley, A. Congdon, A. L. Crossin. Publicity Committee, S. R. Tarr, H. Moncrieff, A. Lindback. Legislative Committee, W. Sanford Evans, H. Detchon, Thos. Bruce.

Boston.

A fire commission for the metropolitan district of Boston with power to make uniform regulations and require the use of sprinklers, as provided for in Senate bill 313, was urged in Faneuil Hall at a meeting called to discuss fire losses and fire prevention.

Under the auspices of the Boston chapter of the National Fire Protection Association, the meeting had also as sponsors the Boston Chamber of Commerce and other local business organizations. Members of the Box 52 Association acted as ushers. A member of the fire department, with the aid of a fire box fitted up in the hall, gave a demonstration of the modern system of fire alarm.

Mayor Curley opened the proceedings by directing attention to Senate bill 313 and asking all who could to urge its passage at the hearing the following day. "I believe this bill," he said, "will materially help to reduce property losses from fire and go far towards preventing the loss of life that now occurs as a result of fire. This large meeting will have a great bearing on the pending measure and may be the means of bringing together in a spirit of co-operation those forces which are necessary to the enactment of a law absolutely essential to the well-being of the entire people of our metropolitan district."

J. Randolph Coolidge, Jr., president of the Boston Chamber of Commerce, gave statistics of the average annual fire losses in the Metropolitan area, showing that for the four years ending 1912 they amounted to $4,160,000 a year, the average for Boston being $2,606,000. He also pointed out that while the average loss per capita for the country was $2.50, that of Boston was $3.29 in 1911, $3.78 in 1912, and last year $4.62, as against 44 cents per capita in England and 49 cents in Germany. Continuing, he said:—

> Why do we continue to pile up a fire loss that is a reproach to our civilization? Our prevalent system of construction, making so large a use of wood both in frames and floor timbers, is the cause of considerably greater fire loss per capita than occurs in countries using stone and brick for the outer walls, with concrete for the floors and tiles, slates or tin for the roofs, instead of wooden shingles.
>
> Another reason is the way in which we allow wooden houses to be placed so close to each other that they facilitate the spread of fire. Any more combustible house than our three-family house of wood, with its front and rear porches, can scarcely be imagined.
>
> A further source of risk is the accumulations of combustible rubbish that are permitted, and this takes place even in office buildings. We have tenement inspection in the interest of the inmates' health, but I have sometimes thought that dwelling-house inspection to prevent fire is almost as much needed, and such inspection, being carried out by the owners of the property, would cost less and save more than the fire department.

Clarence H. Blackall, an executive of Boston chapter and chairman of the Chamber of Commerce committee on fire hazards, explained the purposes of the bill. "We do not claim it is perfect," he said, "but if we can do no more than save a few lives every year it will be more than worth while. The Arcadia disaster would have been prevented had there been sprinklers in the hotel. If the bill works as a law we shall want some more things done next year."

Col. Lewis T. Bryant, a New Jersey member of the N. F. P. A., then gave a motion picture and stereopticon lecture on fire losses and fire prevention. He explained New Jersey fire regulations and showed how that state had materially reduced its fire risks, especially in factories. The means emphasized by him included regular fire drills, proper information to operatives of the location of the fire, proper exits and standardized fire escapes.

Commenting on the meeting several days in advance the *Boston Transcript* said in a leading editorial:—

Next Tuesday a mass meeting of the Boston chapter of the National Fire Protection Association will be held in Faneuil Hall to consider the broad question of fire protection and fire prevention. This Association has a membership that covers the whole country and takes in certain parts of Canada. More than a hundred organizations of various kinds are actively interested, among them institutes, associations, boards and bureaus representing a vast personnel of trained experts, including architects, engineers, insurance underwriters, fire departments and various other allied societies. The declared purpose is "to promote the science and improve the methods of fire protection and prevention; to obtain and circulate information on these subjects and to secure the co-operation of its members in establishing safeguards against loss of life and property by fire."

The object is an exceptionally worthy one and the number of practical men who have addressed themselves to its achievement gives very hopeful promise of progress. The situation all over the country is acute and becoming more so. Yet there has been a constant advance in the methods of dealing with the fire hazard. Means of extinguishment were never before so powerful or so plenty. Departments are better trained and under better discipline than formerly. If the business man or the business firm does not equip himself or itself with facilities for self-protection it is not the fault of the market. There are plenty of devices, like portable extinguishers, sprinklers and the like, which while not absolute assurance against loss by fire are yet a decided factor in the equation of safety.

In spite of all these things the destruction of property and the loss of life continue at a rate that fluctuates more or less at the annual accountings, yet shows no appreciable reduction in a series of years. A quarter of a billion in values, more or less, goes up every year in smoke. We compare our losses with those of other countries and wonder why there is such a great discrepancy against us, especially when it will be conceded that the American facilities for fire fighting are the most ample and in almost all ways the best in the world. We are suffering from the false standards of construction that prevail in a comparatively new country. We are a nation of timber and lumber builders. We have used the material that was most plenty and put it together in a way that would most quickly answer the purposes for which it was intended and we have not yet outgrown the habit.

To a certain extent we are in a transitory stage. We are being aroused to some extent to the need of more substantial and fire-resistant construction, but the idea has not yet got a controlling grip upon legislation. The science of fire protection and prevention should not begin with the finished structure, but start with the site and the architect's or builder's specifications. This is particularly true in Boston, and a truth that has been recently borne in upon our consciousness *by the appointment of a building commissioner who has been among those to set the pace for some of the flimsiest and most inflammable apologies for residences that have ever been seen in this city.* This is the end of the problem at which the Boston chapter and every other chapter of the National Association should begin.

The Boston Chapter held a noon luncheon at the City Club on April 2d to discuss the question of fire protection in the city schools.

Los Angeles.

As the result of letters sent out by Mr. F. H. Cowles, a member of the committee on forest, brush and grass fires, a well-attended meeting of Los Angeles business men was held at the Van Nuys Hotel at noon, January 28th, to form a chapter of the National Association.

Mr. Cowles explained just what the Association is and what a local association could do, and was enthusiastic in the hope that those present would aid in forming such a chapter.

Mr. Garner Curran, editor of the *Insurance and Investment News*, was then appointed chairman of the meeting, and T. H. A. Tiedemann secretary. Mr. Curran called upon Capt. Henry S. Hill, of the Los Angeles Fire Department, for years a member of and ardent worker in behalf of the National Fire Protection Association. Captain Hill went briefly into the question of the annual fire loss in this country, and urged that a local organization formed with the idea of educating the public at large and legislating for better conditions and wider knowledge would be a great help to the entire community. Captain Hill read several reports of meetings in other cities, and explained briefly just how the association could be formed and how it could work.

After a short general discussion it was decided to appoint a committee of three, consisting of Captain Hill, chairman, T. H. A. Tiedemann and F. H. Cowles, to devise ways and means of starting a local chapter.

Among those present at the initial meeting were Garner Curran, editor of the *Insurance and Investment News;* H. E. O'Brien, special agent of the Ætna Insurance Company; G. Mueller, special agent of the Northern Assurance Company; J. Grant Kelly, National Fire Supply Company; H. S. Hill, captain Los Angeles Fire Department; Karl S. Schwendener, engineer, Los Angeles Building Department; F. H. Cowles, forest and brush fire committee, N. F. P. A.; J. H. Morrow, agent Palatine Insurance Company; J. P. Yates, fire commissioner, city of Los Angeles; T. H. A. Tiedemann, insurance firm of Barlow & Tiedemann.

At a subsequent meeting the chapter was formally organized under the direction of an executive committee composed of R. H. Waldron of the Fire Underwriters' Inspection Bureau; E. L. Ellingwood, consulting engineer, Union League Building; Captain H. S. Hill of the Los Angeles Fire Department; Secretary Ryerson of the Los Angeles Municipal League; Karl Schwendener, engineer, Los Angeles Building Department. Mr. T. H. A. Tiedemann (Van Nuys Building), was elected secretary.

The first regular meeting was held April 3d to consider the matter of fireproof schoolhouses, and a meeting is to be held later in the month to take up fire prevention study in the schools, of which Mr. Cowles, organizer of the chapter, is an ardent advocate. Mr. Cowles resides in Oregon, but while spending a month in California undertook the valuable work of organizing the Los Angeles Chapter.

Pittsburgh.

The following officers have been elected by the Pittsburgh Chapter: President, Chas. S. Hubbard, Director, Department of Public Safety, City of Pittsburgh; Vice President, W. H. Coster, Inspector, Board of Fire Prevention, City of Pittsburgh; Secretary-Treasurer, Frank S. Guthrie, member Fire Prevention Committee, Civic Club, Allegheny County. For Executive Committee: For three years, P. E. Zimmerman and Richard Kiehnel; for two years, W. G. Wilkins and W. S. McDowell; for one year, H. H. Robertson and H. M. Wilson.

It was voted to adopt tentatively as the chapter territory Western Pennsylvania.

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Montreal.

A meeting of associate members in Montreal was held in the rooms of the Board of Trade on Wednesday, April 8th, to perfect the organization of the Montreal Chapter. The following public organizations were represented by their officers, viz.:—

Board of Trade, by R. J. Dale, President.

Builders' Exchange, by Thomas Gilday, President.

Canadian Fire Underwriters' Association, by Harold Hampson, President.

Chambre De Commerce Du District De Montreal, by Adélard Fortier, President.

Fire Commissioners of Montreal, by Rudolphe Latulippe.

Montreal Fire Department, by Chief J. Tremblay.

Montreal Women's Club, by Madame H. Fortier, President.

Province of Quebec Association of Architects, by W. S. Maxwell, President.

The QUARTERLY goes to press too early to record the results of the Montreal meeting.

* * * * *

Cleveland.

Through the initiative of our associate member, Mr. H. C. Schofield, Assistant Secretary of the Sherwin-Williams Company of Cleveland, consideration of the formation of the Cleveland Chapter is now under way. Its organization will undoubtedly be perfected soon after the date of our annual meeting, to which the Cleveland Chamber of Commerce is to send a delegate.

* * * * *

Seattle.

Associate members in Seattle are considering the formation of a chapter. Fire Marshal Harry W. Bringhurst has undertaken to perfect the organization.

Fire Protection Engineering Course at Harvard University.

In the absence of a regular technical course of instruction in fire protection engineering from any of the Eastern technical schools, similar to that of the Armour Institute of Technology in Chicago, the graduate school of business administration of Harvard University made the beginnings of such a course during the winter. This course at Harvard has been conducted on the lecture platform, in the field and in the laboratory, by members of the National Fire Protection Association, co-operating with our member, Mr. Wm. B. Medlicott, who has for some years held the important position of lecturer on fire insurance at the University. Mr. Medlicott was assisted in the work of the course by Mr. J. Albert Robinson, of the Underwriters' Bureau of New England, former Superintendent of Fire Records of the N. F. P. A. The object of this course, as stated in the preliminary outline issued by the University, is threefold, as follows:—

First.—To give the student the fundamental features of construction, protection and fire prevention equipment, and of the materials and processes that constitute hazards, and the proper treatment of same to enable him to become a Fire Insurance Engineer or Insurance Rate Maker.

Second.—To furnish men who may become the owners or managers of buildings or business plants with such a knowledge of the fire hazard as shall enable them to intelligently safeguard their property, and to work out such conditions of construction equipment and process as will result in a lessening of the liability to fire, and a consequent reduction in rate of fire insurance.

Third.—To give such a knowledge of what may be done by way of lessening the liability to fire, and effect such a saving in the cost of insurance as will enable the student, should he become a Fire Insurance Broker or Agent, to advise his customers with intelligence on those points that make for the safeguarding of their property and the reduction of their outlay for fire insurance protection.

To accomplish these ends the relations of the hazard and the rate are given due emphasis.

Our members who have made this course a success are Mr. F. E. Cabot, Mr. W. W. Crosby, Mr. Gorham Dana, Mr. Clarence Goldsmith, Mr. Milton F. Jones, Mr. W. H. Kennison, Mr. Isaac Osgood, Mr. Thomas E. Sears, Mr. Ralph Sweetland, Mr. H. V. Thayer and Mr. Franklin H. Wentworth. Each of these gentlemen delivered one or more lectures in the course, which was introduced by Mr. Medlicott on January 28th, and closed by Mr. Wentworth on April 1st. During April the students of the school who had taken the lectures visited the laboratory of the Underwriters' Bureau of New England on six separate days, where tests of sprinkler heads, flash point of oils, the setting up and adjusting of dry valves, the measuring of flow of water from hydrants, the recording of pressure, etc., were carried on in as comprehensive a manner as the limited equipment of the Bureau permitted. In May the students are to have

five field days with inspectors of the Underwriters' Bureau of New England, upon which actual inspections of selected properties that are insured by the members of the Bureau will be made. These inspections are to include mercantile, manufacturing, and electric traction, light and power properties. Four additional days are to be spent with the inspectors of the Boston Board of Fire Underwriters in the actual work of surveying and scheduling for rates. The work will consist of visiting and surveying various properties to determine the features that have a direct bearing on the making of fire insurance rates. From these surveys instructions will be given as to how the schedules are derived, and how the rate is built up. The great value of this course in fire protection engineering as a supplement to the regular university course in fire insurance will be obvious to anyone interested in these subjects. In spite of the fact that this year's course was preliminary, it was thorough so far as it went, and will serve to pave the way for more complete and comprehensive instruction in following years. Harvard University has made a splendid beginning in an important field, which beginning the co-operation of our associate members as lecturers and demonstrators has made possible.

Fire Prevention.

By Robert D. Kohn (President N. F. P. A.).

(From address at Fire Prevention meeting, City Club, New York, March 2d.)

In the consideration of the national as well as the local aspects of the fire prevention problem I am struck with the importance of impressing upon the public the fact that the constructive work of fire prevention cannot be done by amateurs. There is actually and has been for some time a science of fire protection. Although the public generally believes that anything an insurance man does must be done from interested motives, it is none the less true that the most scientific work in the development of fire protection standards has been done under the auspices of the insurance companies. These companies in the past may have been guilty of many high crimes, they may have been badly managed, but be that as it may, the national and local boards of underwriters have for more than twenty years, when no one else was doing it, worked honestly in the finest spirit toward the development of public sentiment for fire prevention. If their work has been interested, that is to say, if it is claimed that their efforts in this direction were interested and really intended to decrease the fire loss so that their own losses might be less, then I say that their selfish interest was a mighty enlightened self-interest and of enormous value to the public. It is interesting to note that it was the National Board of Underwriters which almost fifteen years ago founded the Underwriters' Laboratories at Chicago, an institution which, from my own knowledge, is conducting research work in the finest disinterested spirit.

In these laboratories elaborate and careful tests are made daily of fire prevention devices; devices submitted from every part of the country. Through its efforts standards have been developed of the greatest possible value to the science of fire prevention throughout the world. It is also to be noted that the National Fire Protection Association, of which I happen to be president this year, was founded in the first place by men prominent in the conduct of the great insurance corporations, and that for a great many years they led the fight alone without any considerable help from any other source. It is only within the last five or ten years that the professional men of the country—the architects and engineers—have joined with them and become prominent in the work of the Association. I feel in honor bound to express my obligation to the underwriters' board for their splendid work—to these boards and to the leaders of the mutual insurance interests of New England—men like the late Edward Atkinson, who was the first to interest me in the subject.

In this field of fire prevention, particularly in the matter of inspections, the problem that has to be met is to be sure no different than that which confronts almost every field of reform; namely, to bring in the expert and put him in authority. It is remarkable to note how many of our public offices are held by men who have no technical training, even though the office is one dealing with scientific, engineering or structural problems. Our commissioners of public works are still lawyers; our bridge commissioners are almost everywhere still lawyers; our commissioners of highways are lawyers. Our technical men are lacking in executive ability and political knowledge, and our officials are lacking in technical knowledge, and there you are.

In this question of making fire prevention work effective the public has to be considered. Men are continuing to put up buildings badly constructed, dangerous to life and to other property; putting such structures up mainly through ignorance. The difference in cost of fireproof and non-fireproof construction has been gradually cut down. To-day for structures of any importance this difference is so small that the owner would be amply recompensed for the increased cost by the lower insurance rate. In buildings where the cost of fireproof construction is still prohibitive there are simple protection devices which can be introduced to make a non-fireproof building almost as safe as one of steel and concrete. It is of course in the great manufacturing plants of this country that the science of fire protection has been carried farther along. The device of the fire division wall has been used for thirty or forty years in manufacturing buildings, but for some reason or other has hardly come into general use in any other class of structures. It is perfectly feasible to use such a division wall even in a large country house, a wall that would keep a fire in one part of the building from spreading to the other.

The study of fire protection is a study of hazards. One of our committee has recently divided these hazards under six headings: The first, the hazard of exposures. It does not suffice that a man keep his own house in order, build his building with all modern devices, but he must

protect himself against his neighbors. In certain parts of Europe an owner is financially responsible for damage done to his neighbor's property by a fire that originates in his own house. Had we laws of that character established here, perhaps we would be more careful. As it is, the hazards of exposure are to be fought off by exterior walls, roofs, windows, glass, etc., that will resist danger from flame coming from the outside. In the second place: We have the hazard due to the construction of the building—the more or less inflammable nature of the materials and workmanship. In the third place: The hazard of height and area—a hazard decreased by the subdivision of areas by fire stops, fire walls, enclosures and subdivisions. As far as height is concerned, we all realize that a building above six stories is dependent on its own apparatus for the suppression of a fire. In the fourth place, there is the hazard due to the greater or less efficiency of the fire-fighting equipment of the building, fire hose, extinguishers, sprinklers, etc. Fifthly, there is the hazard due to the occupancy of a structure, the machinery, the character of the contents, whether they be combustible, whether explosive or of an inflammable nature, and whether or not the place is kept clean and in order; the housekeeping hazard in other words—one of the most important of all, what is called the "moral hazard" is a part of this. And finally, we have the effect upon the hazard of the character of public fire protection afforded by the city or community.

Bad Law and U. S. Fire Waste.

By Albert Blauvelt (Member N. F. P. A.)

EDITOR'S NOTE.—The following philosophical arraignment by Mr. Blauvelt of present insurance jurisprudence is both scholarly and interesting. It is a new note in the literature of the fire waste, and deserves careful reading. Mr. Blauvelt's analysis of public insurable interest and its subjection by our present jurisprudence, if accepted, means a new judicial outlook upon the whole subject. We reprint from and by courtesy of the *National Corporation Reporter*, Chicago.

"The first duty of law is to keep sound the society it serves."

This paper submits the argument that our fire waste is fostered by a defective jurisprudence; a jurisprudence which we have inherited and which fails to recognize the existing and natural line of cleavage between tolerance of the form of gambling known as insurance when within the bounds of public policy, and non-tolerance of insurance gambling when contrary to public policy.

To observe this, it is only needful to note the scope or province of the public weal as related to fires, and also to note the jurisprudence of our day as applied to fire insurance and fire waste.

Wagers Among Men in Lieu of Wagers with Fate.

Fire insurance is essentially a gambling contract,[1] and is always attended by greater expense, and often by more numerous temptations than plain gambling.

To illustrate: Assume that a man fully insure a property at a premium of three per cent and also use an equal sum of money to play roulette.

In each case the wager is in about the same ratio or say 33 to 1.

In roulette the expense or bank odds consume about six per cent of all wagers and much of this expense is used to cater to the players. In insurance the selling expense, surveys, rating, etc., consume over thirty per cent of all premiums and much of these expenses goes to cater to patrons.

In roulette the player has no power to attempt to make the ball stop at the wager number; in insurance the insured has the power to withdraw all care both positively and negatively as against burning of the property.

1. The New York joint Legislative Committee's general report of 1911 on insurance makes repeated reference to gambling.

"A man who bets against his horse winning the Derby is precisely in the same position as a man who bets against the safety of his own cargo."

"The law forbids A to make such a contract unless he has what is called 'an insurable interest' in the cargo and contracts in breach of this rule have been called mere wagers. But such a distinction is misleading. It is not that one is and the other is not a wager; a bet is not the less a bet because it is a hedging bet; it is the fact that one wager contract is and the other is not permitted by law which makes the distinction between the two. Apart from this there is no real difference in the nature of the contracts." Anson on contracts. (Second Am. Ed. of fourth Eng. Ed. Knowlton) Page 226 (Star Page 174).

"In this case also the contract is a wager." Hadley, on insurance, "Economics," Page 99.

In roulette, if the ball comes to rest at the wager number the amount payable is fixed; in insurance if the property ignite the insured may be tempted to send in no alarm, or make no attempt at saving any part and also may make claim for more than the actual loss.

Despite these innate disadvantages the body politic has an insurable interest in the burnable property of its members and if insurance wagers be forbidden or unenforcible at law, then men of enterprise are deterred from erecting buildings or venturing stocks in trade, etc.

As the body politic cannot forego the enterprise of its members, and also fears access of ruined or weakened members as a result of fires, the form of gambling known as insurance is perforce[2] legalized in lieu of compelling men to gamble with fate.

Our law does not lose sight of the objections to gambling; this is proved by the fact that a man cannot insure a house not his own and collect at law, the law in all states requiring that the insured own the house, have an "insurable interest,"[3] be able to show that if denied insurance he must then gamble with fate.

Existing Working Conditions.

The mercantile credit and town and country mortgage practice of our country use fire insurance as a safeguard[4] and responding to this demand, both city and country are diligently canvassed by insurance agents working on commission who again cause much insurance to be taken out by small property owners who otherwise would neglect a needful protection, as a result, our public for the most part has some fire insurance, the items of property not reached by solicitors being small, obscure and scattered.

In practice, little property is over insured because to over insure means to pay premium to no purpose except where fraud is contemplated, and, contrary to gossip,[5] fraud losses are but a small part of our fire waste.

Some corporations having scattered property and some firms and individuals having chains of stores do not insure; our Government does not insure Federal buildings, all of which is no more than fair because such interests are incapable of service injury by fire and therefore have no moral ground on which to petition the body politic for permission to lay wagers against fire.

By far the greater number of persons having an insurable interest in burnable property do not insure needlessly, nor neglect to insure at all, and follow a usual practice of each man deciding for himself what insur-

2. "And yet, after all, it must be owned that the law descends greatly from its dignity when it lends its aid to any wager, however innocent." Marshall, 1802 Am. Ed. 1810.

3. The "insurable interest" of individuals is an illogical base for public policy except merely as individual insurable interests in property may coincide with public insurable interest in the same property, there being in fact a vital difference.

4. "In the practical operations of business it has become practically compulsory and property is now almost universally insured against loss by fire." Wisconsin joint Leg. Com. 1913, Page 14.

5. "There are comparatively few cases where the owner or tenant voluntarily sets fire to his property." Montana Com. McCoy, 1912. "The prosecution of cases of arson is a very important part of his work but it necessarily affects but a small part of the total number of fires." Wisconsin joint Leg. Com., 1913, Page 71 on State Fire Marshal.

ance he needs (usually 70 to 90 per cent) and buy same in a manner legal to the state in which the property is located.

In event of fire the insured can use the insurance in either of two ways. For example, if a house worth $1,000 is insured for $700 for five years and there occur a $200 loss and later a $700 loss within the five years, the insured may elect to view his insurance as covering from the bottom upward and claim the $200 loss. He thereby reduces the $700 insurance by $200 and for the $700 loss occurring later would be paid $500. Or, if he view his insurance as applying from the top downward and make no claim for the $200 loss then for the $700 loss he would be paid $700.

The latter idea or plan is so seldom used as to be little known, and the former plan of taking pay for losses if and as they may occur is the operative rule of practice.

The United States Fire Waste.

It is under the foregoing working conditions that our fire waste has developed to present day proportions, now so great as to attract increasing attention as one of the problems peculiar to our land.

The property values destroyed by fire comprise less than half the fire waste,[6] the true cost of which also includes fire departments, insurance expense, private protection, etc.

Such a mode of computation was used by the United States Department of the Interior for "Structural materials"[7] and arrived at an estimate of over $450,000,000 for 1907.

The Joint Legislative Committee of Wisconsin in their 1913 report make a statement to cover our gross fire waste (structural materials, marine and mine losses, forest fires, legal and administrative costs, expectancy of conflagration, etc.), and say "The total is over one half and probably nearly three fourths of a billion dollars a year,"[8] which is more than our wheat crop.

Were this fire waste merely or simply an evidence of the natural improvidence of man and of the custom which has prevailed from time immemorial that nations shall waste their substance, this paper would not be written.

The ugly complication is, unlike the abuse of alcohol, unlike overgrowth of other forms of taxation,[9] the fire waste exposes us to violent convulsions in the form of city conflagrations,[10] and this feature is being

6. "As we permit fire to destroy such an immense amount of property we are necessarily under a high expense to put out these fires and prevent conflagrations." Minn. Com. Hartigan, 1910.

7. Dept. of the Interior, U. S. Geo. Survey, Bulletin 418, "The fire tax and waste of structural materials in the United States," by Wilson and Cochrane, 1910.

8 "Altogether in the neighborhood of $750,000,000 a year of expenditure because of destructive fires." N. Y. joint Leg. Com. report, 1911.

9. "The fire loss is a direct tax on every industry, on every piece of property, and, indirectly, on every individual." Minn. Com. Hartigan, 1910.

10. "In the large cities there is a conflagration hazard. A fire may start in New York to-day which may make such calculations ridiculous and bankrupt most of the companies of the world." N. Y. joint Leg. Com., 1911.

made cumulative by an accelerating frequency of city ignitions per capita.[11]

The Embarrassments of Betterment.

A variety of treatments has long been under trial. These group under three heads:

Regulation of fire insurance.
Construction and Protection.
Education as to Prevention.

Regulation of Fire Insurance: Here we have three embarrassments. First, the very largest fire insurance companies operate over the entire world, they have their seats abroad and apparently are no more and no less responsible for the low fire waste of Europe than for the excessive fire waste here.[12] Hence there seems a fair inference that were our conditions right, this same insurance would be as satisfactory here as it is abroad.[13]

If this be true for the more than one third of our insurance now carried by foreign capital, the same thing follows for the balance, supervised by the same state officials, sold on the same legal forms and carried by American capital.

Second: Our state legislatures for the past many years have been spending about ten per cent of their entire[13] time on regulation of fire insurance. A vast complication and an attendant expense adding to the fire waste has thereby ensued, and while part of the legislative work has been for good, all of it has carried forward a stultification of public and moral policy which will later on be demonstrated.

As a result, the whole stupendous mass of legislation has not checked the fire waste and morally is an image with

"Feet part of iron and part of clay."

Third: It is obvious that cheapening of insurance could go no further than to substitute the cost of some other plan for the present cost of insurance.

Whether any plan could be made to work more cheaply remains year after year undemonstrated in an open market wherein old and new insurance ventures fail in profusion as shown by the investigations and reports of several states.

As pointed out by the Massachusetts Commissioner of Insurance, cheaper insurance would necessitate that the public require less waiting on.[14] Could this be brought about the saving would not and could not reduce our fire waste more than about five per cent.[15]

11. "The United States destroys or permits to be destroyed by fire more property than any civilized country, and our national fire losses in proportion to our insurable values, are from six to twenty times those of any European nation." Illinois joint Leg. Report, Page 904, 1911.

12. "Law affecting the insurance companies will never effect a very great reduction in the insurance cost." Illinois, Supt. Potter, Aug., 1911.

13. To illustrate: 1,625 acts on insurance introduced into various state legislatures in 1911.

14. "But the insured have it in their power to reduce fire losses to a very great extent." "And they also have it in their power to also keep down the expenses." Mass. Com. Cutting, 1906.

15. The same relation holds with regard to insurance expenses on any and all kinds of property insurance such as tornado, plate glass, boiler, etc., and the doctrine advanced in this paper applies to all of such.

Construction and Protection: The embarrassments of fire resistive construction and automatic sprinkler protection are twofold.

First: Our most serious dread is that of a great city conflagration,[16] something which has not yet arisen, because all of our past conflagrations have occurred in cities of about or less than half a million inhabitants.[17]

The most disastrous form of conflagration is that which begins in an outlying poor quarter and by force of wind and despite any fire department burns through the city proper, as at Chicago in 1871.

It is obvious that the expense of reconstructing our cities or of equipping the same with automatic sprinklers would be prohibitive if intended to cover the outskirts. A costly central district can no doubt with public economy be improved to debar[18] conflagration, but no improvement can permanently pay if our cities are to be set on fire with increasing frequency.

Second: If a building have cost added solely to resist fire, or if its utilities of light, ventilation, and of passage from floor to floor are lessened by fire stops, the fire waste is added to by reason of the interest, depreciation and other fixed charges incurred, or by the sacrifice of utility, or both, as the case may be.

Automatic sprinklers, while more effective for a given expenditure than is fire resistive construction (and indispensable for safety to life) incur fixed charges far in excess of the fire cost under the sprinklers, hence sprinklered risks do not connote a low fire waste.[18]

As a result, fire resistance and fire extinguishment, while needful to a degree, necessarily add fixed charges and thereby go to prove that a low fire waste can only be had by fewer fires.

Education: The proponents of education against fire waste are of three general groups—education by police measures, education by information and education through financial inducement.

Police measures have been in use for generations and while of some effect in suppressing fraud[19] by a minority, show no effect on general carelessness by the majority.

We tolerate a limited amount of moral suasion,[20] but if an official to any great extent singles us out as individuals of personal responsibility[21] he is in lively jeopardy of discontinuance in office.

The steady abnormal growth of our fires per capita is the true token that we are not disposed to police ourselves, besides which, officialism is an expense which directly and indirectly is a sensible factor of the fire waste.

Laws to make uniform insurance compulsory, or to make insurance

16. "The great massed insurable values of this country exist in our towns and cities, where they are liable to be swept away by conflagrations which vitally affect every member of the local community; in a lesser degree every citizen of the state; and in city conflagrations, every American citizen." Illinois Commission Report, 1911.

17. Chicago, 1871, pop. 300,000; Baltimore, 1904, pop. 520,000; San Francisco, 1906, pop. 400,000.

18. "Debarment of City Conflagrations." Am. Soc. of Mech. Engineers, 1913 Proceedings.

19. "Some states have fire marshal departments which are more of a menace than a benefit." Michigan Com. Barry, 1909.

20. "Under the character of our institutions it is necessary to use moral suasion very largely." Ill. Fire Marshal, Doyle, 1910.

a governmental monopoly, to treat every fire as prima facie evidence of misdemeanor or crime, to have official investigation intervene between every loss and any payment, to levy the cost of spread of fire against the premises of origin of fire require a permanent military authority for enforcement as in Europe where such conditions undoubtedly account for a part of a lower fire waste.

Ours is a reflex government and we do not and temperamentally cannot (each to control himself and not his neighbor) assume the viewpoint of a fixed and autocratic or military authority, much less accept the same from our elective or appointive officials.

If this is not true, how then account for our enormous mass of dormant statutes on these and kindred lines?

The sympathetic mind will not here condemn; European insurance inverts the moral base of the contract and as a result their restrictive practices are but palliatives of ensuing ill; our aversion to police measures may really be but part of a sub-conscious groping for a righteous plan.

Education by Information: Here again are untoward results.

The effect of correct knowledge of his situation appears merely to oppress the intelligent city property owner, as well it may since he is under double risk of local or general fire. Not wishing to be uncomfortable he resorts to various insurance, including rent, etc., bemoans the cost, seeks the ease of mind he has paid for,[22] and leaves his property to his servants.

"Shall I not take mine ease in mine inn?"

The poorer or less gifted members of the community who as is well known are influenced by the acts (not the words) of those whom they look to as richer or more capable, appear to imitate the standard set by the servants.

Whether the above conjecture is correct or not it is a fact that of Eastern cities Boston, and of Western cities St. Louis,[23] have had for twenty years the greatest amount of intelligently presented information as to the hazard of fire, yet these cities have to-day the greatest frequency of fire per capita of any ranking cities in the world.

Our public both display and elect a sophisticated carelessness, a knowledge that as to fires we may as individuals pay and be as lazy as we please, a view that payment to insurance and payment of fire department charges is a purchase of exemption from conservation, a consciousness that we have over us no military arm as in Europe to enforce regulations against fire waste in order to conserve tax paying ability to the state; a conviction based on the going experience of self and neighbor that with a fire department and insurance paid for it does not pay further,

21. "The chief factor responsible for this situation is general carelessness and the utter lack of personal responsibility for the removal of causes productive of fires." Excerpt from resolution passed at National Convention of State Fire Commissioners at Milwaukee, Aug., 1911.

22. "Yet the security offered by fire insurance is undoubtedly one of the greatest causes of indifference to the cause of fire prevention." Wis. Leg. Com. Report, 1913.

23. See tabular footnote table on city fires between notes 24 and 25.

is not worth the trouble—to be careful. Surely none of these things is untrue and none tokens ignorance.[24]

Education by Financial Inducement: Long trial has shown that this idea is uncommercial under present legal conditions.

This is shown by the fact that insurance for the most part is ever obtainable at about twenty per cent reduction to whoever will assume all risk of the first five per cent of the property value, and at about half price to whoever will assume ten or twelve per cent, the reductions being possible partly because of the fewer claims and largely because of relief from the utterly disproportionable expense of settling petty claims and relief from the frequent and easy exaggeration of loss attending petty claims. Nevertheless but little insurance is and little can be so sold, the zest and illusion of getting back the premium at any opportunity impels men to pay the higher price.

What Is Our Situation?

Considerable comment has appeared in public print in the way of comparison between ourselves and Europe in what would seem an unfair way, such as comparing our fire waste per capita with poor countries and speaking of inconvenient and semi-habitable buildings abroad as if better than our buildings. which lead the world in utility and habitability.

There is, however, no escape from the reproach of frequency of fire with us as compared to the nearest degree of wealth, vice and luxury abroad and what is much more significant the fact that this frequency of ignition is of recent growth.

By the subjoined table * it will be seen that since 1880 our frequency of fire in cities has increased by over three hundred per cent and in 1910 exceeded four hundred per cent over the most comparable cities abroad. The last three years' increase, or since 1910, is so great that our engineers are beginning to believe that no possible extension of fire protection will hold in check the cost rate of burning, to say nothing of what is, to them,

24. "So long as our citizenship views with complacency the destruction of insured property and feels horror only when the property destroyed is uninsured, we cannot expect any improvement or any lessening of the fire waste." Utah Commr. Done, 1912.

*U. S. Leading Cities, Three-Year Averages, Fires Per 10,000 Population.

These figures have been sorted out direct from original fire department records and quote only those fires which must be counted, omitting false alarms, chimney soot blazes, vacant lot bonfires, suburban runs, etc.

	1879–81	1889–91	1899–01	1909–11
New York (Manhattan-Bronx)	12.3	21.8	25.8	35.1
Chicago	15.0	27.0	34.7	38.4
Philadelphia	9.3	11.3	22.0	24.4
St. Louis	10.5	20.5	29.2	46.0
Boston	13.1	16.0	29.6	42.4
Baltimore	9.9	13.9	23.0	26.6
Average of the six cities	11.6	18.4	27.4	35.5

Increase of frequency of fire per capita over 1880, more than threefold. Similar averages for 1909–1910–1911 are for Paris, 7.9, and for Marseilles 5.9, and for Liverpool 8.7 and for Manchester 6.9. For 1909–1910–1911–1912 in London 7.9. Average of the English and French cities 7.46.

an increasing dread of conflagration. This constant increase of city fires[25] has levied its expense thus far largely in fixed charges which are not very visible to the public.

In the broad sense, however, it is a poor and wasteful satisfaction that we should merely, as we do, put out fires at a more incipient stage and with more engineering and acrobatic skill[26] and at an enormous expense as compared to any other nation.

If, as some say, this frequency of fire is due to the prevalence of frame construction,[27] why has not the frequency lessened inasmuch as shingles and frame since 1880 have been very largely eliminated in our leading cities?

If, as apologists hold, the frequency is due to luxury, the ease of making fire calls by telephone, etc., why do not luxurious cities as London and Paris show such effect and why should we have over four times as many fires per inhabitant?

Does not this accelerating frequency of fire indicate a progressive adverse sophistication of our state of morals,[28] a state of morals wrought by our jurisprudence through license of gambling in petty losses in which the public has no insurable interest?

To illustrate:

Varieties of Moral Status Under Law.

Taking up the bulk of actual insurance, the insurance is partial, which necessarily means that the average insured declares himself as able to cope with fate as to part of the value of the property insured. Our public policy in turn waives public insurable interest in such cases by reason of not compelling insurance.

This is but fair, as few men have all their resources and prospects exposed to one fire, and also in any case can endure a reasonable shortage of reimbursement.

Under existing jurisprudence we have necessarily many phases of moral status.

For example, property insured at 90 per cent of its value and located within fire department protection:—

As a thousand fires occur[29] the outcome is: A small number of losses (3 per cent to 5 per cent) ranging from 90 per cent to total, whereupon the insurance is paid in full, and (1) public policy is satisfied because the insured, reimbursed to the extent of 90 per cent, will not become a weak member of society, and (2) the insured is cared for by the collection of his

25. "In the rural districts the buildings are widely separated and contain property that does not compare with that in the cities, yet the losses are as great in these districts." Bulletin 418 (see Note 7).

26. "The fire departments of Europe are far less efficient than in this country." N. Y. Leg. Com., 1911.

27. U. S. Consular report, Jan., 1912, shows Tokio, Japan, as having 2,717 fires in five years, or a highly inflammable city as large as Chicago and with about one-tenth the fires per capita.

"Switzerland is a country of wooden houses, yet the per capita fire loss there last year was only two per cent of the American per capita loss." Am. Soc. Mech. Engrs., 1913, Emerson, Page 1,274.

28. "The record of the state of Maine is one to be ashamed of and statistics show irrefutably that criminal carelessness and negligence is at the bottom of the Maine situation to a considerable extent." Maine Com. Harvey, 1912.

wager, and (3) public policy has waived public insurable interest in that part of the loss which exceeds 90 per cent, and (4) the insured stands the loss over 90 per cent because he earlier agreed that to that extent he would gamble with fate rather than with his fellows.

A considerably larger number of losses (25 per cent to 35 per cent) ranging from 10 per cent to 90 per cent whereon the loss is paid in full, and (5) public insurable interest more than satisfied because the public waived the bottom 10 per cent, and (6) the insured keeps all the salvage and cashes his bet for all his loss despite his waiver of need for public aid as to 10 per cent of the property.

A numerical majority of losses (55 per cent to 70 per cent) amounting each to less than 10 per cent of the value of the insured property, whereon (7) public policy has no moral right to legalize the collection of loss because a waiver of public insurable interest was earlier established, and because the amount of the loss cannot constructively be assumed to injure the insured as a member of society, and because the insured by agreeing to gamble with fate for 10 per cent thereby waived outright that extent of reimbursement under public policy; and (8) the insured has the felicity of gambling *per se* under the moral encouragement of, and cashes his bet with the support of the law.[30]

From this it seems reasonable that withdrawal of law is more needed than addition to law.

Lines of Cleavage.

Where the insurable interest of the public does cease in any given instance can be determined with fairness from the action of each insured.

Obviously the insurable interest of the public must first contemplate a total loss, since thereby the public incurs greatest risk of access of a weakened member and this interest and scope of public policy diminishes as any loss becomes partial and necessarily ceases altogether when the loss becomes small enough not to seriously weaken the individual. A person having burnable property may by error lack insurance, and by fire be made a weakened member of society, but such cases are so infrequent as not to appear to call for compulsory insurance and our law does not so compel.

Public policy therefore assumes no jurisdiction and has no moral ground upon which to permit gambling upon losses within any limit of risk voluntarily assumed by an individual or owner and also no moral ground to license wagers to reimburse any insured to within the insured's

29. The Universal Mercantile Schedule referred to by legislative committees as the base of city rating in the east says for fire department cities:—

"68 per cent of the losses in number are under $100 in amount.

"15 per cent are over $100, and less than 25 per cent of the value of the property.

"7 per cent in number are between 25 per cent and 50 per cent.

"5 per cent are between 50 per cent and 80 per cent.

"5 per cent are over 80 per cent of total."

Inquiry shows that the above quoted proportion of small losses has of late increased. Country losses average a larger percentage of such property as is subject to one fire, and now also show an increasing frequency.

30. This touches on the well-known legal principle that all contracts by which a principal wholly relieves himself from penalty incurred by neglect of himself or servants are unsound as creative of or maintaining public risk; as of conflagrations.

reasonable ability to bear loss, particularly as shown by his bearing the loss of the premium.

The Right and the Wrong.

To attack the fire waste problem directly,[31] imagine that our courts could rule that all fire insurance wagers be construed as covering from the top values downward (not from the bottom upward as now) on the ground that public insurable interest begins at the top or in contemplation of total loss and ceases or is waived at whatever sum various insured may elect to stand to lose as shortage and premium—also on the ground that to bear initial loss outright to a degree within the normal fluctuations of fortune is consistent with public policy which in other things requires each man to bear the like as his part of a self-reliant citizenship.

In such event, the law would at least sustain the truth that all public insurable interest ceases short of full recovery by the individual for any loss. There are indications and business reasons for belief that the public, did it find itself unable to resort to insurance as a petty gamble, would voluntarily assume outright a wholesome percentage[32] of the value of the property, this would create an incentive to make fire prevention education effective on both servants and children and also to find means of defense or offense against bad neighbors.[33]

Who may cherish faith in our nation could under such conditions have offer of belief that our sophistication would seasonably reverse its now obverse side, and reveal the true image and superscription of our genius in the form of resource and care.

Reduction of waste by burning and reduction of fire waste fixed charges is only a hope and not the theme of this paper, this plea being for that phase of our situation which is a plain question of the right and the wrong.

Our jurisprudence does now lead us into temptation and abets gambling in a huge multiple of instances, as against each real service rendered to public insurable interest, and the said needless gambling does increase our fire waste, if not obviously in all directions, then obviously on the side of the fixed charges.

Fire waste is admittedly in large part a state of morals, and moral law compels that a jurisprudence of faulty moral concept, or lack of moral concept, cannot but affect unfavorably all things it may touch.

31. "We are waiting for the time when we shall be intelligent and far sighted enough to attack this problem directly." N. Y. Leg. Commission, 1911. Page 50.

32. "I would favor the adoption of a law suggested recently by the National Association of Credit Men, compelling fire insurance to leave a margin of about ten per cent between the actual value of the property and the amount of insurance that could be collected in case of total loss. Such a measure would, I believe, effectually bar any evilly disposed person from burning his own property to collect the insurance." This comment by Comm. Done of Utah, Nov., 1912, in a way, exceeds the intent of the Credit Men's Bulletin of Oct., 1912, which, while it met with no dissent, was incited by the writer as a credit discussion, not as a suggestion for more laws.

33. "Students of the subject all agree that the greater part of fires are easily preventable." Wis. Leg. Com., 1913.

The Fireproof Building: Its Advantages and Its Weaknesses.*

By H. W. Forster (Member N. F. P. A.)

Recently in running through some proceedings of the British Concrete Institute in preparation for this evening, I discovered that the English, as well as we, were arguing among themselves the question whether the term "fireproof" can properly be used, and they came to the same conclusion, as have all our American engineers, that "fire resistive" is the proper term. But "fireproof" seems to have so strong a hold upon the world that the term will continue to be used, although it is somewhat of a misnomer.

The fireproof building which we are discussing to-night will be of the many storied type, containing combustible material. It will not be necessary to more than touch upon the steel mill building, common in the Pittsburgh District, having a steel frame with corrugated iron covering and nothing in it of a combustible character. But we are particularly interested in a structure of the office or warehouse or factory type and of fireproof construction.

What do we expect of a fireproof building? I believe we expect three things. First, that it shall preserve its contents against fire, originating within or outside the building. Second, that the building itself shall withstand fire successfully. Third, that every fireproof building shall be a barrier to conflagration. I think that you as engineers are convinced that conflagration is something which always menaces us, and I am prepared to certify that there is not an American city in which conflagration is not possible.

What has been the showing made by fireproof buildings? This can be summarized under two heads. First, fireproof buildings have failed in practically every conflagration to protect contents or to escape without much structural damage except in the few cases where the window openings were protected with wired glass windows or shutters. Second, fireproof buildings can resist, in varying degrees, fire breaking out within them.

Fires have been confined entirely to small sections, as in that memorable case in the 26th story of the Singer Building about a year ago. Much advertising use was made of that incident. Two rooms burned out completely and metal doors kept the fire in those rooms. The fire department, which required about twenty-five minutes to get up to that level, had nothing to do but put out the embers.

* Presented before the Structural Section Engineers' Society of Western Pennsylvania.

Buildings have suffered considerable damage, as for example the State Capitol Building at Albany, N. Y. You will remember that fire in which five or six million dollars of damage was done, principally to the finish of the building and to the contents.

Finally there are fires such as that in the Equitable building in New York, in which the structure was razed because it was so badly damaged. It was a very poor and old type of fireproof building.

What are the reasons why fires damage buildings? In our fireproof construction we very frequently have large unbroken areas. This was true in the Equitable building. Our large department stores, which are nearly all fireproof, have in the majority of cases excessively large areas and there is a real menace in that. Next, and more important than the factor of areas, is the tendency on the part of builders and designers of buildings to connect them from the bottom to the top by means of open light courts, elevators, stairs, ventilating and dumb waiter shafts, and other unprotected openings through floors. In other words there is small chance, if a fire is well under way, of its being confined to any one floor. It goes rushing up these draught holes, and spreads throughout the building. Heat tends to rise and it travels very rapidly.

Then there is another cause for our buildings failing so frequently, and that is the lack of protection of window openings. We build fireproof buildings and build them well, then fill them full of combustible material and leave hundreds of openings in the walls protected only by wooden window frames and plate glass. Wood begins to char at 500° Fahr. It burns at 700° to 800°. Any respectable fire will develop a temperature of from 1,800° to 2,000°, and a moderate amount of radiant heat will cause such windows to fail. The fire annals are full of cases of fireproof buildings being more or less burned out by reason of the lack of window protection. I have sometimes likened the degree of intelligence which leads a man to put up a building of the valuable modern type, without protecting the windows, to the intelligence of a man who would build a safety deposit vault and put a wooden door on the opening. What is the use of fireproof construction if it is left vulnerable at so many points?

The serious fireproof building losses are primarily due, not to faulty fireproofing of steel, but to large areas, unprotected vertical openings, and lack of window protection. A fireproof building ordinarily is nothing but a stove full of material that can burn, and waiting for some one to touch the match. If we have a good stove it is not damaged appreciably by what burns in it, but a poor stove fails. That is about the simplest and homeliest comparison that we can use for good and bad fireproof buildings.

One of my acquaintances in Rochester, N. Y., sat down with a competent architect in his city and figured out that the ordinary office building about 100 ft. front, 150 ft. deep and twelve stories high, contains in the form of fixed combustible material, comprising floors, moldings, door and window frames, partitions, stairs, stair rails, and similar structural parts, enough combustible material to run the Mauretania twenty-four hours, which I recall burns 1,200 to 1,300 tons of coal during that period. The

older type of fireproof office buildings will probably contain fifty per cent more combustible material. If we add to the combustible portions of the building the combustible contents, ranging from a few chairs and desks to a dry goods store stock we have wonderful heat producing possibilities.

Occasionally statements appear in print regarding the temperatures which are reached in fire. Usually they are exaggerated. As has been pointed out a good sized fire will produce temperatures of from 1,800° to 2,000° Fahr., and a fire which has a particularly large amount of material to feed it and good draft conditions will develop temperatures up to 2,200°. Some fires are authentically known to have gone higher than that. When we consider that concrete begins to dehydrate at 500°, and that steel beyond 1,000° to 1,200° loses its strength rapidly and at about 1,700° is incapable of sustaining its own weight, it is seen that a temperature around 2,000° can do tremendous damage to an improperly designed or built fireproof building.

What principal forms of fireproof buildings does the market afford to-day? First, steel frames with tile floor arches, column protection, and partitions; second, steel covered with concrete; and third, reinforced concrete.

Steel-tile buildings are undoubtedly most common, but I presume that there is some doubt as to whether steel-concrete or concrete-steel are the more common forms involving the use of concrete. I think that some fireproof buildings protected with gypsum and expanded metal and plaster may be properly left out of this discussion. The proposition resolves itself into two types of construction, viz., steel and tile, and steel and concrete, or reinforced concrete. After attempting for a number of years to follow closely the fire experiences with buildings of these types, and reading diligently the literature which the profession affords, I believe that the majority of engineers are agreed that, the quality of design being good in each case, the building which is protected with concrete has superior fire resistive power to the building which is protected with tile.

It does not follow, necessarily, that the concrete building is always the one to use, but it has superior fire resisting powers. I have listed some of the reasons why that is true.

First. Steel and concrete expand at substantially the same rate; steel and tile do not. Clay tile has a coefficient of expansion practically twice as great as steel. Obviously this may cause trouble.

Second. Concrete protection, for a column for example, is in one solid mass. Tile fireproofing, on the other hand, is made up of a very large number of comparatively small units held together with mortar, with defects introduced by careless labor, and requiring bonds, which are frequently omitted.

Third. Tile expands more rapidly on the heated side than on the unheated side. The ordinary column protection consisting of a four inch tile with an outer and inner face about 0.75 inch thick, will expand rapidly on one side and very slowly on the other, and when broken the air space protecting value is lost.

Fourth. There is great temptation to do poor work in setting up fire-

proofing tile. Recently in a building in Chicago I saw some new marble finish going in, and when the workmen took down the old finish about one tile in ten was found to be defective. The same thing is shown after conflagrations. The soffets of floor tile will be missing when the finish has fallen away.

Fifth. The difficulty of setting tile for protecting girders and beams must not be overlooked. The customary practice is to put a tile of special form on each side of the beam and use a skew-back to protect the lower face. It is difficult to get these parts to fit, and it is difficult to avoid some movement at the time of fire and to prevent the falling away of considerable protection. A very common practice is to put tiling on the sides and then merely expanded metal and plaster on the under side. That looks good after the building is finished but it is of course simply inviting disaster.

So much for the comparative value of concrete and tile. We may safely assume that concrete from the fireproofing standpoint is superior, but we immediately face the question as to whether we should always use it. Tile is lighter and consequently cheaper, and is universally used in high structures. In view of the fact that high structures are usually office buildings, which have the minimum of combustible contents and comparatively small areas, I do not feel that a good tile is unsatisfactory for such a building. But in the ten and twelve story class I believe that concrete, either reinforced or used on a steel frame, is materially better and sufficiently cheap to warrant it being earnestly considered. In the case of the factory building of four, five, or six stories, which is to carry heavy floor loads, be waterproof, and have inexpensive finish, the factors are altogether in favor of steel-concrete or reinforced concrete. If, however, a building has elevator shafts, stairways, and outside windows protected, and is cut up into small areas, the question of what form of construction is employed is much less important because fires will be comparatively small and localized.

The next question is one of the amount of fireproofing which is necessary to insure the integrity of the structure. I have been interested to see the report of the Joint Commitee on Reinforced Concrete Construction. That Committee recommends that columns should have two inches of protection, both steel-concrete and reinforced concrete, though that was a committee on reinforced concrete. It says that on girders 1.5 inch is sufficient and on floor slabs 0.75 to 1.00 inch is enough. British practice exceeds that slightly, perhaps 50 per cent all along the line. Our American fire protection engineers raise the Englishman 50 per cent, so we believe that important columns should have as much as four inches of fireproofing, and at least three inches for a building with reasonably combustible contents; that girders should have two to four inches of protection, three inches being about the average; that less important floor beams should have two inches of protection, which is the minimum that we desire at any point. As far as I have been able to discover, the tests which have been made of the distance to which fire will calcine concrete, indicate that penetration seldom exceeds one inch.

The statement was made that the reason concrete does not calcine very deeply even in long continued and hot fires is that the air spaces which are

formed by the moisture driven out have an insulating value, and in calcining the concrete naturally takes up heat from the material back of the face exposed to the fire, and that tends to slow down the penetration speed. But if we are to admit, and I think we have to, that one inch of penetration is possible and likely in a serious fire, I do not think we should consider less than two inches of protection at any point.

Fireproofing, which is provided for steel frames, viz., around columns, girders, and beams, must be reinforced. In other words, expanded metal or its equivalent must be carried around columns and the soffets of the beams and girders and be firmly fastened in place. Then a rich concrete mixture must be well tamped so that it gets through the reinforcement and fills up the voids. That sort of treatment is necessary. Otherwise the entire protection under the action of heat may fall away from the face of the steel.

I was interested in reading a statement, made by one of our American college men who is qualified to speak, that the tendency of calcinable stones to split up and cause surface disintegration is just about equaled by the tendency of poorly burned cinder to burn somewhat more, and he argues that the ordinary stone concrete and cinder concrete are equally good. From a fire resisting standpoint I think that may be said to be true.

The next question I should like to discuss is the one of cutting off the floors from each other. If you civil engineers were called upon to design an office building, 25 stories, like the one in which we are this evening, you would figure on the wind bracing as well as on the columns and beams to carry the dead load. You would not judge it good policy to figure wind bracing for 30 miles an hour simply because you thought the wind would never exceed that rate, or because in the last ten years the Weather Bureau did not show any winds beyond that velocity. Similarly, if you were putting up a fireproof building you could not assume that a fire is going to be confined in the office where it breaks out and not seek elevators and stairs and spread upwards. The fire annals are full of instances where fire in fireproof buildings of good types has rapidly traveled up elevator shafts and stairways and even private stairways connecting two or three stories of a New York apartment house, or up from window to window in outside walls, especially in angles in walls and in deep courts where a chimneylike action may be produced.

If you are going to put up a good structure you must remember that the elevators should be enclosed. The usual method is to place metal and wired glass doors in brick, concrete or like shafts, which gives good results because fire has to get through one door, go up the shaft, in which there is nothing to burn and break through another door in order to get into the next story.

Put the stairs into shafts, and see that they are as good in fire resisting power as the floors. The openings should have good fire doors. Do not build ventilating shafts and dumb waiters and line them with wood, for these make excellent flues. The Equitable fire, for instance, was caused by an employee of the Savaran Cafe striking a match, which was thrown into

a waste basket. Fire broke out in the office. It traveled up the wooden lined dumb waiters, which led to the Lawyer's Club and one or two other points, and very quickly the fire struck the roof, mushroomed, and worked downward against the concentrated efforts of the greatest fire department in the world.

The next question is one of exposure. I have called your attention to the fact that buildings are continually burning out through fire entering the windows. The conflagration annals show that in almost every case, fireproof buildings have been burned out completely. The individual fire annals show that wherever there is a real exposure adjoining or close to a fireproof building, which does not have wired glass to protect it, the building suffers. Every man who knows anything of proper building construction realizes that almost his entire safety against sweeping fire is dependent upon his window protection. Wired glass windows in metal frames can be installed at very moderate expense, about 1.5 or 2.00 per cent extra on the cost of the building. They will look fairly well, and will keep out fire. Shutters are almost entirely out of the question on office buildings, and usually so on the street sides of industrial buildings. They are frequently put on to reduce the rate, seldom if ever closed, but are allowed to rust and decay, and when the crisis comes the shutters often fail woefully. There was a large fire in Cincinnati about two years ago in which seven buildings in the mercantile district were destroyed, in broad daylight, with favorable weather conditions. Almost every building had shutters on the sides and back, but nobody closed the shutters, because they were forgotten until the temperature was too high to operate them. So the fire spread across the alleys and the streets and two or three million dollars worth of property was destroyed. If the windows had been wireglassed the fire department could undoubtedly have confined the fire to one structure.

Some of you may have heard my good friend Franklin H. Wentworth when speaking in Pittsburgh. Mr. Wentworth is a powerful advocate of such window protection. I consider wired glass a most valuable adjunct for a fireproof building subject to any exposure, and it is worth while simply to keep fire from traveling upward via the outside windows. There was a fire recently in the Emerson-Brantingham office building in Rockford, Ill., fireproof, tile floors, non-combustible finish, fireproof stairs, almost no partitions, and little that was combustible in the form of contents. It looked like an A-1 proposition. It was, by ordinary standards. A cigarette deposited in a wastebasket, it is believed, set fire to a desk. The second floor was burned out and fire went via the outside windows and stairs into the third floor. The Mutual insurance companies paid an $80,000 loss, and then the edict went forth that there must be sprinklers in fireproof office buildings. Window and stair protection would have helped keep down the loss.

The last topic is the character of fire fighting equipment that is warranted in different forms of buildings. In hotels and office buildings, which are our principal downtown fireproof structures, it is not necessary except in case of extreme height to require complete equipment with auto-

matic sprinklers. All basements and sub-basements should, however, be protected with automatic sprinklers. I was present at a basement fire in Seattle, and went away with renewed enthusiasm for basement sprinklers. It is a serious proposition to ask firemen to fight basement fires, for there is plenty of combustible material in the ordinary fireproof office building basement. For very high buildings sprinklers should be absolutely demanded. St. Louis has the correct idea. Any building over a moderate number of stories has to be sprinklered.

The fire department in the ordinary American city, working from the street, is helpless above six stories. Ex-Chief Croker of New York, at the Asch building disaster investigation testified that his department was helpless over 85 feet above the ground except when it could reach the fire by means of stairways or elevators which were safely protected against fire. If there were a fire raging in this building, say above the 10th floor, what chance would the Pittsburgh fire department have? It would probably have to content itself by keeping the fire from getting below that floor. Outside fire escapes are no panacea. They are immediately exposed to the flame, and are often difficult and frequently dangerous to travel.

Standpipes we all believe should be provided in big buildings. If any of you has any influence with persons putting in standpipes, look with disfavor upon anything smaller than six inches. At the Equitable fire, various fireproof and modern buildings nearby had standpipes and the fire department utilized them. It was found that one or two good streams could be taken from a four-inch standpipe, but when more were taken off the pressure dropped very decidedly. Friction losses in a four-inch pipe are four or five times greater than in a six-inch pipe, and the friction losses mount up rapidly. Standpipes of six or even eight-inch diameter are necessary. The best thing of which I know is a combination of a 2.5 inch connection for the fire department and a 1.5 inch connection, with fire hose, for the use of the watchman, janitors, or others who are not trained to handle large hose. If a tank is on the 28th floor it exerts a very considerable pressure on the hose which may be attached to the standpipe on the 10th floor, and it would take experienced men to hold it. The foot hold on a marble floor is not good, and serious accidents may be occasioned by hose lines getting away from men.

Outside sprinklers are not generally advisable. It takes a tremendous mount of water to wet down a large number of window openings. You have to figure about ten gallons per minute per window. I do not know how many windows the Oliver Building has, but I would guess about 100 to the floor, and, for 25 floors, this would be 2500. At ten gallons per head you have 25,000 gallons per minute. Probably the fire engines in the downtown district of Pittsburgh do not have a capacity in excess of that, and they are not going to pump water into a sprinkler system when there are more urgent demands. Chemical extinguishers are needed throughout the building. The type labeled, "upset-to-operate" is best, and these extinguishers have a good range, do the minimum amount of water damage, are filled easily, and most people to-day have some idea of how they operate.

There is one more point to be considered in connection with the fireproof building, and that is the alarm system. Fire alarm systems are usually designed to call together the fire brigade but not to get out the people. Frequently, they do both in industrial plants, but not often in office buildings. Objection is usually made that an alarm going off in an office building would cause a panic. But it becomes a question of possible panic, or of possible loss of life. In the case of an office building it is a very difficult problem, because you are not able to drill the occupants as in a factory where you have them under authority. I do, however, believe a fire alarm system in a building of this kind is necessary to warn the occupants and to get the fire-fighting forces promptly to the point of trouble.

In conclusion: Fireproof all steel in an adequate manner; protect all vertical openings; provide wired glass windows for all exposed buildings; install fire-fighting equipment in proportion to the hazard; and provide means for notifying occupants of a building promptly in case of fire.

Discussion

MR. MCDOWELL:* I understood the author to state that cement would be calcined to a depth of about one inch in a very hot fire. What would be the effect of this calcination? Would the outer material wash off? Is gypsum an approved covering or protection for columns?

MR. FORSTER: If a fire stream struck the cement it would wash off in part at least. Gypsum is not generally approved for such use. At one time it was approved in New York City, but I do not know whether this holds under the new code or not.

MR. MCDOWELL: What is the objection to gypsum, what defect does it have compared with concrete or tile, as a fire protection for columns?

MR. FORSTER: I think gypsum is in the class with tile for column protection and especially for partition work. I consider it as good as tile. As compared with concrete it has the distinct weakness of being put up in sections, in blocks cemented together, instead of being a homogeneous mass, and its heat penetration records, which are the only ones I know of, are inferior to those of concrete. I have seen some Underwriters' Laboratories tests, which indicate that a temperature of 1,800 to 1,900 degrees maintained for a period of two or three hours would get into gypsum for a distance of three to four inches. I am speaking from memory on this point.

MR. HILES: Is it possible under existing laws in the various states to require the erection of fire towers in connection with buildings so that it would not be necessary to depend on city ordinances? Is there any other form of fire escape which can have the same approval as the Philadelphia fire tower? What would be the additional expense to incorporate a fire tower in a twelve-story building of the factory building type where a large number of operatives are employed?

MR. FORSTER: Such legislation is coming, but not state-wide as far as I know. In Philadelphia we are very much interested in the new state building code, in which that may be incorporated. New York is requiring the fire tower for certain structures, and so is Chicago; practically every city in the country has some fire towers. Philadelphia used the fire tower coercively fifteen years ago. I live in a three-story apartment house and it has a fire tower at one end.

There is nothing else in the same class. The disadvantages of the outside fire escape are that it is easily reached by flames and smoke, it is frequently obstructed

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by snow and ice, and, being more or less open, people are afraid to travel down it. It is not a customary avenue of travel or as easy as the Philadelphia fire tower, which is a part of the building and is protected and dry. We recently had, at the Architects Institute in Philadelphia, an interesting evening in which we discussed the inadequacy of the various types of fire escape apparatus. If you wish to ask my opinion as to the best thing to do in a building, I would say put in a division wall with just as few openings as possible; protect these openings with fire doors, move people horizontally through the wall, and close the fire doors. The Philadelphia fire tower, or enclosed stairway, would be very desirable even in connection with such building.

The additional cost of constructing a fire tower is not very great, because the fire tower can be used as one of the stairways of the building. In Philadelphia the code specifies that there must be at least one fire tower for any building, and the number shall be increased in accordance with the floor area and height, and inside stairs may not count as fire towers. Fire towers may to a reasonable extent take the place of stairs, but not entirely, as they are out in the cold. The chief difficulty regarding the fire tower is not the cost of installation, but the loss of revenue from the floor space which it occupies. A fire tower with its stairs and wall thickness will require a space of about 10 by 20 feet, say 200 square feet in each floor, and with ten floors and a basement, 2,200 square feet of floor space. If space is worth $1.00 a foot per year the owner suffers a distinct loss. In other respects it is practical and very desirable. Every kind of building in the downtown district of Philadelphia, including buildings which are three stories and higher, used for manufacturing and for the congregation, or housing, of people is required to have a fire tower. Philadelphia has a very good building code. It covers practically all the essentials that can be covered without making it burdensome. Atlanta, Ga., has a model code. They prevent the erection of buildings three stories in height or over within 30 feet of any other structure, unless protected with wired glass or shutters, and they specify that all this equipment shall bear the label of the approval of the Underwriters' Laboratories.

MR. MCDOWELL: Referring to cinder or stone for fireproofing concrete, what is the value of cinders as a material, or aggregate, for fireproofing?

MR. FORSTER: I think I can safely say from a limited knowledge of the records which have been made that hard burned, clean cinder either from anthracite or bituminous coal, free from coal or other combustible matter, and properly mixed with sand and cement, makes excellent fireproofing material.

MR. DUFF:* It struck me that there are a good many things here that have not been brought out by the questions so far asked as to details of construction, etc. We ought to be congratulated to-night particularly on the fact that we are hearing this question discussed from the right standpoint. We have had here, several times, descriptions of fireproofing and fireproofing construction from manufacturers of fireproofing material, and designers of fireproof buildings, each of whom took his own view. We are hearing to-night from men who are interested in preventing fires, because it directly pays them to do so. They have collected a tax, as Mr. Forster has said, for the purpose of paying some of it back in fire losses, and it is their part to so conduct their business and to so educate the people as to prevent fire losses. This is the proper standpoint to hear from to get at the meat of the question, and I think Mr. Forster has presented it in a wonderful way. The details of the construction are of course so varied that it is almost impossible to go into that. But I think this discussion particularly applies to Pittsburgh right now, because from my observation, without any prejudice one way or the other, I think we are about as far behind here as we can get. I think if Mr. Forster's remarks could be spread broadcast where the people who have to pay for these things could study them, we might get something done in Pittsburgh on this question of fire protection.

I do not know just what the ordinances are in the City of Pittsburgh in regard

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to the reconstruction of buildings, repairs, etc., within fire limits, but anybody can see that the builders do practically as they please. As long as they do that the menace from conflagration that Mr. Forster predicts will occur some day, threatens our city. Therefore the point he makes that a fireproof building must be arranged to protect itself from fire from the outside is a very strong point in connection with Pittsburgh construction, because the lower part of town is so honeycombed with cheap, flimsy construction that some day we will have this big fire, and it will be a big fire because there is so much material to feed on. If we are to have fireproof buildings here they must be protected absolutely from fire from the outside. I cannot recall any building just now that is.

It seems to me this view of the situation ought to be brought before the people who pay for things in the city of Pittsburgh, because the insurance companies are tax gatherers, as has been said, and they gather enough tax to protect themselves and we all pay it. And in that way we should use our efforts and influence to see that anybody who spends money for construction follows proper laws for fire protection as far as possible.

Another important point is that the only material which withstands fire and thus provides an adequate screen for metal is brick or clay. Fireproofing of the clay type, as Mr. Forster says, is not always entirely adequate, because it is put together in small pieces and it is not always properly put together. Concrete seems on the whole to give the best results, though he shows that the heat of conflagration will affect it considerably, to a depth of 0.75 inch, or more. Isn't it possible that somebody will design some clay fireproofing which will not have to be put together in such small pieces as it is to-day, and which, by some method of joining or construction, will approximate the continuity of concrete protection. Possibly we will then have something as good or better than concrete. It seems to me that the use of unprotected reinforced concrete is a menace to the fire-resisting reputation of concrete on account of the inadequate protection of the steel. This is shown in the photographs shown on the screen to be absolutely true where floor slabs and girders are exposed to a temperature anything like 1,700 or 1,800 degrees. I mention this point to make clear to some, who possibly did not notice it, that a building of structural concrete is not entirely fireproof for the reason that it will not resist high heat. Therefore, it is necessary to protect it in some other way, or by the use of sprinklers keep the fire from getting to that high temperature.

MR. FINDLEY:* I would like to call your attention to two examples of good construction in this city. One is the dormitory of the Western Theological Seminary, which in addition to being built of concrete and steel is provided with an outside fire-escape tower of the Philadelphia type. The other is the newer part of the "Grant" exchange building of the Telephone Company, which is provided with wired glass windows throughout. The windows of the operating and terminal rooms are kept closed, all the ventilation being supplied artificially, and these windows are provided with automatic rolling metal curtains on the outside. The present practice is to equip all the company's buildings with steel doors throughout, and to provide sand pails, gas and chemical extinguishers, asbestos blankets and heavy gloves in adequate number. Most rigid rules are enforced against bringing any combustibles such as benzine and gasoline into operating and terminal rooms.

I would like to ask a question as to the use of tin-clad doors. If well made according to engineering standards, would they not be a fair substitute for wired glass?

Do you not think that all elevator enclosures should be tightly constructed of metal or wired glass? In other words, would you not consider an elevator enclosure of metal lattice or grille work a bad type of construction?

MR. FORSTER: Tin-clad doors, properly made would be superior to wired

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glass. All elevator enclosures should be encased in tin-covered wood or wired glass and metal. Open lattice or grille work is a bad type of construction.

MR. MCDOWELL: How much heat will a tin shutter stand for a period of forty or sixty minutes, and how long will ordinary wired glass stand?

MR. FORSTER: We have, in the Underwriters' Laboratories in Chicago, a testing furnace with openings in the brick wall five feet wide by seventeen feet high. Into that furnace we build up blocks of clay and cement, install wired-glass windows, and hang tin-clad doors, shutters, etc., and then we turn on the gas and create a temperature up to 2,000 degrees or over. The ordinary test is of one hour's duration, the temperature running up to 1,600 or 1,700 degrees fairly rapidly, and then more slowly to perhaps 1,800 or 1,900 degrees. A tin-clad shutter or door, if the tin is laid with locked joints, is just about as strong in the joint as in the sheet, and the wooden core under the action of the heat gives off gases which issue and are burned, and the core is gradually reduced to charcoal. Properly designed and constructed a tin-clad shutter is superior to wired glass. But we have almost no first-class shutters as regards original design, they are not well maintained and frequently are not shut. That is the reason I so strongly advocate the use of wired glass. It is less effective but always on the job.

Glass melts at a temperature of about 1,600 to 1,700 degrees. However, if an exposing building is burning, an adjoining building protected with wired glass is not steadily subjected to billows of flames, and the glass is not kept at a temperature of 1,600 to 1,700 degrees except momentarily. The glass is shattered, but if it is well put into the grooves it stays there. At the Laboratories a window, after being heated for an hour, is run out of the furnace, and a stream of water at 60 pounds pressure is thrown into the center of each pane of glass. Under this severe test it must not fail, the reason being that if the wired glass gets hot and the fire department strikes it with a stream it will blow out unless properly held.

MR. KINNEY: I noticed in the department store of McCreery & Company that the fire doors at the elevators are equipped with fuses. The question arises in my mind as to whether these fuses will melt and prevent the use of the elevator even though it still be in service. Should not such doors be inspected frequently? As they slide into the partition they might become rusty and fail to act when required.

MR. FORSTER: Your point is a natural one and reasonably well taken. The only fault in the argument is that if it is hot enough in the neighborhood to melt the link it is too warm for people to be escaping that way. There must be an air temperature of around 250 degrees to melt the ordinary sprinkler head or fire-door link. Sliding doors are acceptable, or the doors must swing with the travel. The sliding door has the advantage over the swinging door of being readily made automatic. Such doors must be frequently inspected and the chances are, in a department store, that the fire doors are closed every night. Even in such a case it might be possible to pull the doors shut and yet they would not be sensitive enough to close automatically. Every well-regulated business to-day has a fire inspection staff to look after just such maintenance problems.

MR. KINNEY: Our building code now in process of formation calls for 0.5-inch protection of reinforcing metal on the bottom of floor slabs. What would you think of such a provision?

MR. FORSTER: On the evidence that I have set forth to-night, that seems to me as though it were "flying in the face of Providence," to put it mildly. The Joint Committee recommended 0.75 to one inch, one inch in the latest report. One picture I showed to-night of the Johnson Building in San Francisco is a case of one-inch protection, and you saw the result. I think anything less than 1.5 inches anywhere in a reinforced or concrete steel building is not practical.

MR. SCHATZ:* After listening to the previous remarks, there are a few points I would like to refer to.

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First, the question of using concrete or cinder fill under floors. One serious objection to cinder fill is that if a considerable amount of water is allowed to leak on the floors, as a result of fire or otherwise, and the water finds its way through the cinder fill and floor arches, it invariably ruins the plaster on the ceiling below the cinders, causing discoloration of the water, and in turn of the plaster. It has been found impossible to remove this discoloration by painting or treatment of any kind, and the only way to have a satisfactory paint job or decoration on plaster where discoloration has occurred, is to re-plaster. Another objection to cinder fill is that in a very hot fire cinders store up heat and create a furnace effect. Our company has adopted sand and gravel concrete for fill under floors, of a mixture of one part cement, three parts sand and seven parts gravel.

Referring to standpipes for fire purposes, we realized some years ago that a four-inch pipe was very inefficient, and had installed a five-inch one. Our experience has been such that if we were installing another one, it would be six inch. We have provided on each floor connected to the five-inch standpipe, two 2.5-inch standard fire department hose connections, using a reducing coupling on one outlet for a two-inch fire hose inside. We have provided a hose rack containing 100 feet of linen hose on each floor, excepting the basement, where we have double the amount provided. This standpipe is connected to a house pump (which also serves as an emergency fire pump), causing pressure to be on the standpipe at all times the steam boiler plant is in operation. The standpipe is also connected to a steamer siamese, and in addition is coupled up with the city water service by means of two four-inch metered lines. This latter service is connected to two different twelve-inch street mains, the different supplies being "checked" one against the other. The only source of water supply not automatic, is the city water service, which is hand operated and must be opened on Sundays and holidays, or at such times as the steam plant is shut down. We have the standpipe located inside the building at a fairly central location, and also convenient to an inside fire escape, making it very accessible for the fire department in case of fire.

Reference has been made to outside sprinklers. About eight years ago our company had installed 300 outside sprinklers on the four upper stories of our buildings, on the four sides. The water is controlled by valves located in the basement, hand operated. The water supplying the outside sprinkler system is furnished through four six-inch supplies, connected to twelve-inch mains located on three different streets. These several connections are coupled under the sidewalk to what we call a six-inch belt line, which serves to connect the sprinkler risers with the city mains. A number of tests which have been made on the system referred to, have shown the good effect they have on the outside of the buildings, and with a water pressure of 100 pounds at the street, there was a drop of only seven pounds pressure in the belt line which supplied the different risers. The height of the buildings referred to is about 120 feet from the sidewalk to parapet. On a building in Pittsburgh, situated in the down-town section, and not exceeding 140 feet in height, outside sprinklers should prove of great value. I might add that a building properly equipped with both inside and outside sprinklers gives the insured a feeling of security which could not possibly exist if both systems were not installed.

MR. FORSTER: Have you ever had occasion to use your outside sprinklers?

MR. SCHATZ: Not for fire purposes. In regard to fire shutters, we had a fire in the building back of us, a distance of about eighteen feet. The objection we find to fire shutters is that they rust very quickly, especially at the bottoms. Where wood tinned construction is used on inside doors for fire, we find they dry rot. We are familiar with the method suggested for avoiding dry rot, but have not seen it tried out long enough to fully understand its advantages.

MR. FORSTER: You have touched upon some very interesting points, but I have a limited period of time, which has already been overrun some fifteen minutes.

It is difficult to rebuild our cities, but it is entirely feasible to cut out three fourths of the fire possibilities by proper care of existing buildings, and great advance will be made in this country through our Fire Departments. New York

in the old days spent $12,000 a year for fire prevention and $8,000,000 for fire fighting, a ratio of 666: 1, a very small ratio in view of the fact that prevention is at least as important as protection. New York to-day has a large fire prevention bureau, and Chicago also. Philadelphia is well under way, using its firemen for inspection work; and while arranging for fire prevention they are also learning the buildings in which they may have to fight fires later on. We are proud of our firemen inspection departments.

MR. KEIM:* Am I correct in understanding that the outside sprinkler system should be entirely separate from the inside system?

MR. FORSTER: The outside sprinkler system should be a dry-pipe system with open heads. The open sprinkler system is a wonderfully good thing if there is enough water. But speaking generally the open sprinkler is not the way to protect a large building from conflagration, because in case of a conflagration in Pittsburgh, even with your high pressure, where are you going to obtain the water supply? What happened in Baltimore? In San Francisco the earthquake broke the pipes. That is the reason for window protection which does not take water to defend the building, and for having in the basements and under the floors of the basements of our large exposed city buildings large reservoirs and steam pumps. The electric pump with a reliable current supply is a fine thing. The California Electric Company's building, which was shown on a slide, had an electric fire pump installed, but what saved them was the fact that they had gravity water. We cannot beat gravity for reliability.

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Smoke and Water Damage.*

By F. E. Roberts, Toronto (Member N. F. P. A.)

SMOKE AND WATER DAMAGE.—This damage to buildings and machinery is not touched upon, only that to stocks in mercantile buildings and factories. The fact that while a loss on a building may be moderate, the loss on stock is liable to be heavy, leads to this proposition—"Given even an ordinary brick or concrete building, with good fire protection, a moderate loss on building may be expected, and a relatively large loss on stock. This discrepancy is due in most cases, not so much to the actual fire damage to stock, as to the effect of smoke and the water used to extinguish the blaze."

A sure way to prevent this damage is to extinguish the fire when it is of small proportions, which means a small amount of water used, and a minimum of smoke. For this purpose an equipment of first aid fire extinguishing appliances should find a place in every mercantile and manufacturing building. Such apparatus, including casks or fire bucket tanks of water with pails, chemical extinguishers, etc., are too well known to need description. The equipment to be selected depends on the size and character of the risk and above all on how far a man can be induced to go in protecting his own property. The "first aid" from the fire department is also of great value. This consists of the same chemical fire extinguishers recommended for private use, now in the hands of firemen, supplemented by the chemical engine, which is nothing but an enlarged form of the extinguisher, capable of throwing a continuous stream of water impregnated with carbon dioxide gas, for as long a period as such small streams are likely to be of use. First aid private fire protection, and first aid from the fire department, one or both, have saved millions of dollars worth of property, and are especially effective in saving smoke and water damage. Anything that can hasten the appearance of the brigade "chemical" at a fire should be heartily encouraged.

I come now, however, to the point which is perhaps of most interest —how to lessen the smoke and water damage in the many fires where a large amount of water has to be poured on the blaze and where smoke is abundantly in evidence.

The first requisite is to follow the rules of good building construction, and to do so more closely than is generally the case. Briefly, so far as smoke and water damage goes, this means no unprotected floor openings, in fact no floor openings whatever except for stairs and elevators, no concealed spaces on walls or ceilings, absence of easily combustible partitions and finish, in fact let the wood be confined as far as possible to floors, beams and supports for same. Protection to elevator and stairs means enclosing in walls of brick or concrete with standard fire doors at

* Paper read before the Insurance Institute of Toronto.

openings. Two or three inch wooden enclosures may make a substitute, but it cannot be called an equivalent one. As to trapped elevators and stairs such treatment can have no place in any scheme of preventing smoke and water damage, nor indeed can I consider the usual traps seen as anything but a very unsatisfactory way of preventing spread of fire.

The reason for advising no floor openings, except elevators and stairways, is because so often the effect of such properly protected openings is weakened by improperly protected chutes, dumb waiters, etc., and by belt holes. There is only one way of properly protecting a chute or a shaft for a dumb waiter—that is, treat it exactly as an elevator. It is practically the same thing, only smaller. It is certainly better to omit such openings altogether. Something may be accomplished in the way of protecting a belt hole, but as for making it anything but a serious defect in an otherwise whole floor, I have never seen it done—I do not believe it can be done. There is such a thing as a belt tower, with transmission of power by shaft to various floors. It is expensive to construct, and besides, in these days of electrical power, belt holes are not necessary and should be dispensed with.

The division of a risk by fire walls, into as small areas as the needs of the business require, with fire doors at openings, preferably each side of wall, is advised. This means something more than the confinement of a fire to the section where it originates. If a fire happens in an undivided large area, and is fortunately confined to half or less of that area, there will undoubtedly be a heavy smoke damage, probably water damage as well, to a stock on the entire floor, not damaged by fire. If a fire of equal extent happens with the area divided by a fire wall, there will probably be only a small smoke damage beyond the fire wall. Some damage may be unavoidable, as fire doors will not keep out smoke entirely.

It may be thought that concealed spaces, combustible partitions, ceilings, etc., do not directly affect smoke and water damage. But a fire that gets into a concealed space on ceiling or walls is difficult to extinguish. Much ineffective water has to be used, with a corresponding unnecessary water damage to stock. Thin board partitions and like finish and fixtures, especially if nicely varnished, are easily combustible fire wood. They not only produce smoke themselves in burning, but furnish excellent kindling for stocks not so combustible, which will burn or smoulder in such circumstances and pour forth volumes of smoke.

Elevator and stair shafts should have skylights at head, but not entirely of impermeable wired glass. Flat skylights should be of thin glass protected by wire netting. If of monitor type, top can be of wired glass, sides of thin glass. Smoke inevitably collects in stair and elevator shafts, fire doors or no fire doors. If fire penetrates to a shaft filled with smoke an explosion may be the result, the force of which should find an easy vent upwards, if not, the thin glass is easily broken to let the smoke out. The sooner the smoke finds an exit the better. Indeed it would be a good thing if a permanently open ventilator could be arranged, or a vent similar to the one now used over a theatre stage operated from below.

One of the best safeguards in a theatre stage is a vent above, which can be opened at once by an electric device in case of fire, from either the electrician's station or from the ticket office. Such vent can be arranged instead to open by fusible link attachment as well as by hand from some convenient point. While wired glass windows are installed almost wholly as a safeguard against exposure from some other building or section, I would point out the fact that fire very often spreads from one floor to those above, via the windows. In the well known Triangle Waist Company fire in New York, which started on the eighth floor, that is exactly the way it spread to the ninth and tenth floors above. In a recent fire in Toronto it followed the same course.

What I have said applies to smoke and water damage both, but there is a second requisite which applies especially to water damage. That is waterproof and drained floors. If a man puts up a new building with single floors, or in an old building will not make the floor double, the question might as well be dropped. Mill construction floors, or even ordinary double floors, can be so treated. Asbestos paper, weighing 14 pounds to the square of 100 superficial feet, is often laid between the 3-inch thick, or more, mill floor and wearing, hard wood, three fourths to seven eighths floor above, or between the two seven-eighth inch boards forming the ordinary double floor. Possibly the fire retardant qualities of this sheet of asbestos might do some good after eating through three inches of solid wood, but the only advantage I can see is that if the 3-inch floor is poorly seasoned timber, with resultant wide cracks, it might impede the progress of flame to some extent. Planking, where there is an exposed corner, will ignite quicker, and burn more freely, than when the fire can attack only the flat surface. I have more faith in its virtues in the case of an ordinary double floor, but it is somewhat limited. I am reminded of a closet for workmen's oily clothing I saw once. It was a fair closet for a wooden one (which are not desirable), but unfortunately it was turned wrong side out, covered with metal on outside, instead of lined inside, where fire was likely to occur. Whatever may be thought of the fire retarding qualities of this thin sheet of abestos paper, it is not waterproof. Leave the sheet of asbestos there if need be, but do something toward providing a waterproof coating as well. With the asbestos, or without, the ordinary double floor, or even the mill floor, cannot be called waterproof. I think the man who banks on a mill floor being waterproof, because it consists of four inches or more of wood, and possibly a sheet of asbestos paper, is likely to find his confidence misplaced, when a fire occurs requiring considerable water to extinguish.

The recommendations for a waterproof coating, between the top layer of wood flooring and that underneath, are about as follows, according to views advanced by N. F. P. A. and others:—

Two layers of waterproof paper (resin sized generally mentioned), joints swabbed with tar, pitch or an equivalent, overlapped at least two inches. If paper is not waterproof, the entire surface of lower layer to be swabbed with tar, pitch or an equivalent and upper layer placed on

lower while hot. Waterproofing to be flashed up three inches above floor level at walls, columns, pipes, conduits, or any other point where floor is pierced. Waterproofing to be completed after plumbers, electricians, etc., have done their work. Especial attention must be paid to waterproofing at walls, columns, etc., mentioned, which are points of weakness. No single layer of even a good waterproof paper is likely to give efficient water protection. It is recommended that floors where feasible be built with a pitch of about one inch in 20 feet, draining to scuppers in outer walls, or to stair and elevator shafts. In the former case, where the scuppers are simply laid flush with the floor, the form recommended has a square opening 12 by 4 inches at floor, running in a downward direction through the wall, and narrowing near the outer surface to 4 inches square. A flap cover outside the wall remains closed by gravity until rush of water opens it. A shallow metal gutter is sometimes inserted at outer walls, plain straight scuppers 3 or 4 inches square, or in diameter, being used.

There is one objection to draining to outer walls, at least in Canada. In our cold winters, with penetrating winds, in spite of the flap covers more cold air finds its way in than is comfortable for workmen employed near the walls. They get cold feet, both literally and in a slang sense, a convenient rag stuffed in the orifice keeps out the draught and incidentally puts the scuppers out of business! In warehouses, or in places where little or no work is done, this objection would not apply and indeed in such situations a scheme of pitching the floors seems most feasible. Where there is much machinery, pitching the floors may impose difficulties in the proper alignment of machinery. The natural outlet for the water appears to me to be the stair and elevator shafts. When the firemen sweep the water off of a floor after a fire, there is where it goes. It may be impracticable to pitch the floor to such opening in many cases—for instance when there is but one elevator and stairway at the end of a long building. Where the elevator and stair shafts are located near the center of a long side, or when there are more than one of each, it can be done. Drains could be installed in the center of floors connected by piping underneath to the down pipes from the roof that often run through the building, or to elevator and stair shafts. The number of such drains needed would be small, not more than two in some cases to a floor. In any case there should be a pit at bottom of all elevator and stair shafts and basement floor pitched to the same, with drain of ample size connected to sewer.

It may be remarked that supposedly waterproof floors have leaked. I need only call attention to the fact that careless workmanship cannot be expected to produce good results on any part of a structure, certainly not in waterproofing a floor, which requires care. A single layer of waterproof paper, carelessly laid, joints not swabbed with waterproof material, points of weakness mentioned not looked after, would defeat the object in view, and I am inclined to believe, if a properly drained floor leaks freely that is where the trouble lies. But there is a "fly in the ointment," at

least some consider it a fly, I believe it is only a small sized gnat. It is this—the top floor is nailed to the lower floor, the nails necessarily passing through the waterproof paper. This should make practically no leakage, provided the under or mill floor is neither shrunk nor swelled to any extent. The under floor, however, is of ordinary lumber, the upper of hardwood (maple usually), kiln dried. This wearing floor is not laid till the building is nearly completed, and until the roof is on, and the under floor is subjected to any rains that may occur. Consequently after the building is finished, and floors thoroughly dried out, there may be a shrinkage of the under floor, carrying the nail with it, bending the nail, or possibly tearing a small hole in the paper. It will be noted that the other end of the nail is imbedded in the top floor, which being originally of kiln dried lumber does not shrink.

I do not think this shrinkage is large in many mill floors, and therefore results in waterproofing will not be serious, but there is a possibility of some leakage if water remains on the floor, which is one great reason why there should be efficient drainage. Even where the floors are not perfectly watertight, owing to above, I believe with proper drainage the water damage will be materially lessened, and in the majority of cases a most gratifying result will be accomplished. The floor of 3 inch planks, splined together, appears preferable to one composed of plank on edge spiked together. Possibly a plastic coating of waterproof material laid between floors might be preferable. I do not know whether it has been tried or not. The subject is one of sufficient importance to warrant much more attention than it has received, for the number of buildings with waterproof and drained floors is very low.

As to cost, I think the insuring public generally get very good interest on money laid out in safeguarding their property. It is true, in some cases, the reduction in fire insurance premiums obtained for an improvement is considered as being an unsatisfactory interest on the outlay. At the same time, an equal rate of interest offered on any other safe investment would be deemed a very attractive proposition.

The simple expedient of raising the stock off the floor, placing it on skids or platforms 6 inches high, will save some damage, even without waterproof and drained floors. A stock of tarpaulins, kept for the emergency of fire, or better, used every night to cover the stock, is also advisable. A municipal salvage corps could do great service with proper equipment. I have spoken of the necessity of "first aid" fire extinguishing appliances of the fire department appearing on the scene at the earliest possible moment. Well, the salvage corps should arrive a little ahead of the "first aid." I think such a corps is a proper part of a municipal fire brigade. Reducing damage to property, as well as extinguishing the fire, seems an entirely proper part of a fire brigade's duties. No doubt efficient service is rendered as to this in many cases, possibly in most, so far as the equipment provided will allow. In some cases—well, firemen are mortal like the rest of us, and liable to error. Provide

against smoke and water damage due to human fallibility by good construction, and waterproof and drained floors.

Watchmen and signaling systems should be of great service in minimizing extent of fire, and therefore of smoke and water damage. A watchman is theoretically supposed not to start a blaze, but must discover a fire promptly, turn in an immediate alarm and either extinguish the flames with first aid apparatus, or do yeoman service in holding the fire in check till help arrives. Unfortunately fallibility has been proved in all of these qualifications, failure to discover a fire promptly, to use fire extinguishing apparatus intelligently, or a combination of the two faults being most common. A check on a watchman's movements, or lack of movement, is essential, especially as an incapacity for anything else sometimes seems to denote special qualifications for a watchman. The best check is undoubtedly connection with a central station. It is but just to say that in a majority of cases watchmen are of service. As to whether preference should be given to a standard thermostat system connected to a central station, or to the above, I decline to express an opinion. The thermostat discovers and gives notice of a fire much sooner than can be expected of a good watchman—on the other hand it does nothing to extinguish the fire. What I would really like is a combination of both. What I have said is intended to apply wholly to unsprinklered risks. For a really scientific discussion of the merits of watchmen and signaling systems as applied to sprinklered risks, I recommend a recent article in the QUARTERLY of the N. F. P. A., by Mr. Albert Blauvelt.

While what I have said may seem to apply only to joisted and mill construction buildings, it certainly does apply, in the main, to modern "fireproof" buildings as well. The specifications for some buildings, even after it was discovered that unprotected metal was not exactly fireproof, might be interpreted about like this. "Build a tall stove, posslbiy neglecting any protection to such an unburnable article as cast iron columns, put in more or less kindling in shape of partitions, finish, etc., fill it with the necessary contents, generally not bad fuel, leave the draughts open and go away with the proud consciousness of having solved the fire problem at last." Now this idea has been thoroughly exploded, not alone by conflagrations, which is perhaps too severe a test, but by isolated fires, resulting not only in a practically total loss on contents, but in serious structural damage as well. As to structural damage, the construction was undoubtedly faulty, but would probably have withstood a fire confined to one floor by properly protected openings; it could not stand up under the raging furnace within, due in great part to unprotected openings. It is obvious in such a "fireproof" building that the smoke from a fire providentially stayed short of complete destruction of contents, can damage stock as easily as in any other kind of building, with similar openings, and that such openings certainly contribute nothing to saving water damage.

I regret to say, that judging from some comparatively recent erections,

the idea of unprotected floor openings in fireproof buildings is not yet entirely extinct in Canada.

It is perhaps not so obvious that fireproof floors are not necessarily water-tight. In the Triangle Waist Company fire in New York, the deplorable loss of life has deservedly obscured any mere property damage. Still we may consider this item from report of the fire: "Non-waterproof floors and floor arches resulted in great water damage to stock on floors below the fire." I will call to mind the construction of this building: "Cast iron protected columns, steel girders and floor beams, protected by hollow tile arches." In short, a fireproof building, of construction much the same as can be seen in buildings now being erected in almost any large city. The construction was efficient, so far as damage to the building was concerned, little structural damage being caused, though the three top floors were completely burned out.

A fireproof building of the protected steel frame, flat arch type of construction, cinder concrete fill on top of arches, with sleepers imbedded to receive a wooden top floor, so far as waterproof floors are concerned, is probably not so good as ordinary mill construction.

As to reinforced concrete buildings, anyone who has observed the comparative ease with which water penetrates to concrete cellars, in many cases, will not have an abiding faith in the water resisting properties of ordinary concrete. It is of course equally possible to have the floors waterproof in either type of fireproof construction.

If stock in a fireproof building is to be in an approximate degree as safe from destruction as the building, the floors should be absolutely cut off and waterproofed. Drained floors should be an additional qualification, if feasible.

If I have said nothing heretofore about the merits of a sprinkler system for averting not only fire loss, but smoke and water damage as well, it is not because I do not consider that system the one most desirable. I sincerely hope that the ratio of sprinklered to unsprinklered buildings will be greatly increased in the near future. But it is certainly true that, for some years to come at least, unsprinklered property will form the bulk of our buildings. Hence I would be justified in devoting the whole of my paper to such types of buildings, where extensive smoke and water damage may be expected. But I do not propose to exempt sprinklered buildings.

The sprinkler system in some buildings, and under some circumstances, is not an absolute cure-all for smoke and water damage. In the first place, the rules of good construction I have in part outlined must be followed to get the best results from sprinklers. In point of fact they are followed to a great extent, or we should not get the gratifying result that statistics give us. While the turning on of water from sprinkler heads is automatic, the turning off of supply, after fire is extinguished, is not automatic, but dependent on human agency, which has sometimes proved faulty. Still it appears from statistics that more damage has been done by turning off the water too soon than by letting it run too long.

Now in the first case, when the flow continues too long, is the water damage confined to contents immediately within range of the opened sprinkler heads, or indeed to property on that floor? Certainly not, when the floor is non-waterproof. In the second case, the fear of such damage, with non-waterproof floors, may directly influence some one in charge to turn off the water too soon.

Take the case of where sprinklers operate only the time that is necessary. An average of five sprinklers opening in a fire I believe is not excessive, nor a flow of twenty minutes. Five heads, say in mill construction, will protect a space of about 480 square feet. These sprinklers, under a pressure of 40 pounds, which should be obtained in this district of Toronto on the third floor, possibly on the fourth, will discharge about 4,000 American gallons or 3,400 Imperial gallons. If the water were confined to space protected by sprinklers it would mean nearly one foot of water on the floor. Of course it is not confined, some is absorbed by stock, the rest is distributed more or less over the whole floor. With non-waterproof floors is it not reasonable to expect considerable loss to damageable goods on floors below?

It has been said by a good authority that the water damage in the case of automatic sprinklers rarely exceeds that necessary to extinguish a fire, if the system is properly shut off. Undoubtedly that is the fact, if one considers the stock only on that floor, but if the floor leaks, inflicting loss to stock below, it is unnecessary damage. I do not think the highest type of efficiency of a sprinkler system can be reached, unless the floors are waterproof and drained, especially with a valuable stock subject to extensive water damage.

For a shining example of "how not to prevent smoke and water damage" as well as spread of fire, take the ordinary large department store. The wide area, the absence of effectively cut off floors, the character of the stock, and the method of display, all make for a full measure of smoke and water damage, if fire is providentially extinguished before complete destruction ensues. It is indeed fortunate that the danger of such establishments is now well recognized and that standard sprinkler equipments, effective fire appliances of all kinds, and good supervision, are the rule rather than the exception. Without such a system a large department store is something more than a poor fire risk—it offers opportunities for a holocaust too dreadful to contemplate.

I have omitted after all the most obvious recommendation for preventing smoke and water damage—"Don't have a fire"—that is where fire prevention comes in, and I hope the present movement in this direction will not be allowed to lapse, without results. In the meantime, as fires will probably happen before the millenium is reached, let us try to do something to lessen losses by smoke and water, as well as by fire.

Dust and Smoke Explosions.

By P. D. C. Steward (Member N. F. P. A.)

1.—Dust Explosions.

It is not the purpose here to enlarge upon the dangers of well known high explosives such as nitro-compounds, fulminates, etc., but to call attention to the many apparently simple and harmless substances in which danger is hidden until some entirely unexpected circumstance may cause a succession of events resulting in disaster.

Numerous organic substances, made up chiefly of carbon, hydrogen, oxygen and nitrogen, such as alfalfa, bran, celluloid, chaff, charcoal, coal, cork, cotton, dextrin, feather, flock, flour, grain, lampblack, leather, lycopodium, malt, naphthalene, paper, resins, starch, sugar, sulphur, tan, tow, wood, or wool dust; or in fact any kind of combustible dust will explode with violence under favorable conditions when mixed with the proper proportion of air and ignited by a flame or spark. "The chief reason for this ready inflammability of dust is the occlusion of atmospheric air or other gases, by the minute particles of dust, which act like an absorbent sponge. Laden with gas or vapor these dust particles form a highly inflammable material, which ignites with great rapidity, forming an atmosphere of hydro-carbons and carbon monoxide that furnishes with the remaining air an explosive mixture, which is ignited and exploded by the flame of the burning dust. Consequently, dust explosions occur in two stages, the ignition of the dust particles, and the explosion of the resulting and ready formed gaseous products. These phases follow in such rapid succession as to practically form one operation. Pure metallic dust of various kinds may also explode without the presence of any gas besides air. Both organic and metallic dusts become far more explosive when mixed with substances liberating oxygen."

Explosions may be remote from open lights or fires, the presence of open chutes, stairways and elevator shafts allowing clouds of dust to fill all intervening spaces, thus permitting a flash-back to the source of dust production. "An atmosphere of dust may be in contact with a flame without explosion, because the precise conditions are not present; but the moment these conditions arrive the flame shoots through the mass with ever increasing energy, and explosion follows." The infrequency of explosions, with the different substances or dusts mentioned, is chiefly due to the absence at times of the conditions necessary to produce an explo-

sion. The inflammable substance must be in a very finely divided state; the diffusion of dust must be complete within a circumscribed area; there must be an absence of excessive humidity, and there must be direct contact between the explosive mixture and a flame, or a spark of sufficient intensity to ignite the mass.

In sprinklered buildings conditions favorable to an explosion are frequently nullified by the opportune opening of sprinklers, which furnish an excess of moisture tending to cool the atmosphere of dust below the point of ignition.

Dust from fibres dyed with certain chemicals which absorb oxygen is much more hazardous than that from the raw stock, thus the combustibility of a fibre increases directly with the avidity it has for the oxygen of the air.

With the exception of coal, flour and starch, wood dust is probably produced in larger quantities and by a greater number of processes than any other organic dust, and at the same time it is handled more carelessly than any other dust. The necessity of its rapid removal to avoid congestion around machinery often makes its safe disposal a difficult problem, involving large outlay for dust collecting systems which in themselves are often responsible for fires and explosions that occur through friction of neglected or improperly lubricated fan bearings. The breakdown of dust collecting machinery has been the indirect cause of explosions with loss of life, resulting from efforts to dispose of dust and shavings by direct hand firing while the collecting system was inoperative. Wood dust explosions have been caused by dislodging masses of shavings and dust from projections in the walls of vaults, and the clouds of dust becoming ignited by open lights or furnace fires nearby. The "Hog," a machine consisting of a heavy iron-toothed cylinder revolving rapidly within a strong casing, for the purpose of breaking up wood waste to facilitate disposal by the collector system, is a large producer of dust, and nails or other bits of iron striking sparks have caused serious explosions.

The dust from sandpapering machines being naturally very fine and dry, and produced rapidly in large quantities, must necessarily be conducted to some receptacle by a blower system, and therein lies the danger of thorough diffusion with an abundance of air extremely favorable to rapid combustion.

The proper disposal of dust of any description is direct from the machine by which it is produced through well constructed smooth metal piping or conduits and exhaust fan, to a ventilated and screened centrifugal dust collector, preferably above the roof of building, and thence to the proper receptacle, storage vault or furnace, as required by the nature of the material.

Coal Dust. The frequency with which disastrous explosions with great loss of life have occurred in mines has caused the United States Bureau of Mines to make an exhaustive study of the conditions which lead up to mine explosions, and the methods of preventing them. It seeks to determine what explosives can be used with least risk in mines

where gas or inflammable dust may be found. In the ordinary process of breaking down masses of coal, large quantities of dust are produced and this is often ignited by unsafe lamps and by the explosives used in mining.

Coal dust explosions also occur in the coal grinding mills of cement plants, where the dust is used as fuel in the rotary kilns.

Anthracite coal pulverized for use as foundry mold facing may explode violently.

Other Explosive Dusts. Grinding and sifting powdered sugar in the presence of open gas lights caused an explosion in a Philadelphia refinery in 1891. A large number of empty barrels lined with tissue paper were standing about, and the paper was ignited in nearly all. Forty-seven sprinklers were opened by the intense heat.

In modern magazine binderies the edges of the books are trimmed by circular saws or knives, resulting in an immense amount of fine paper dust. This dust is often chuted to the basement waste paper vaults and under favorable conditions would cause an explosion.

Dust explosions also occur in grain elevators, flour and cereal mills.

An explosion attributed to dust in the spaces between the outer walls and wooden grain bin cribbing in the Northwestern Elevator, about 1896 or 1897, caused destruction of the building with loss of several lives.

Bark mills and buffing in tanneries; dusters and rag cutters in paper mills; bolting reels in starch factories; starch shakers and sifters in candy factories; malt mills; alfalfa mills; cork mills; wheat and other cereal cleaning machines, buffing and polishing wheels, etc., are sources of plentiful dust production. However, the escape of flour and sugar dust is a waste of product and these substances are more carefully guarded in modern plants. Dust from manufacture of celluloid articles is violently explosive.

2.—Metallic Powders.

Bronze Powders. When metals or their alloys are reduced to impalpable powder they become readily ignitible. When packed and stored in a perfectly dry state there is little danger in such materials, but when exposed in a loose condition to the action of air and moisture rapid oxidation proceeds, and the gases given off from these metallic powders are liable to explosion in the presence of carriers of oxygen.

Aluminum, copper, magnesium, zinc and various alloys of these metals are more commonly found in the form of bronze powders, and the danger of explosion is practically the same with powder from one metal or from two or three metals in combination.

Flashlight Powders. Aluminum and magnesium powders, mixed with chlorate of potash and other carriers of oxygen for intensification, ignite readily, are highly explosive and under certain conditions are extremely hazardous.

These metallic powders, of various kinds and for the variety of purposes intended, should be kept in cool dry places perfectly free from moisture or atmospheric air (this applies as well to both place of manu-

facture and place of storage); the grinding mills must be perfectly dry; open lights should be prohibited and friction or anything likely to cause sparks must be carefully guarded against. Electrical appliances must be in perfect condition to avoid arcing.

3.—Smoke Explosions.

As an explanation of many contradictory statements in reference to explosions that are reported to have occurred in burning buildings, where it is also testified that explosives were non-existent, we may cite so-called "smoke explosions."

Distinct from, yet closely allied with explosions of inflammable dust, are explosions caused by the ignition of mixtures of air with the minute particles of unconsumed carbon and invisible gaseous matter in smoke from the imperfect combustion of organic substances. A transparent film of smoke deposited upon a glass slide and examined under a powerful microscope presents the appearance of numerous particles of carbonaceous matter in a finely divided condition, each particle being surrounded by a coating of oily or tarry matter. This deposit is the soot that, in combination with dust, blackens all buildings in manufacturing and railway centres.

These "smoke explosions" frequently occur in burning buildings and are commonly termed "back draughts," or "hot air explosions." Fire in the lower portion of a building will often fill the entire structure with dense smoke before it is discovered issuing from crevices around the windows. Upon the arrival of firemen openings are made in the building which admit free access of air, and the mixture of air and heated gases of combustion are ignited with a flash on every floor, sometimes with sufficient force to blow out all the windows, doors of closed rooms where smoke has penetrated, ceilings under attics, etc. Where buildings are provided with iron shutters tightly closed the force of the explosion may be downward through stairway and elevator openings. Light inflammable material will invariably be ignited by the flash of smoke explosions, thus putting the fire beyond immediate control. Experiments have demonstrated the explosive nature of smoke from various organic substances, and have proven that the sudden spread of fire to all floors of a closed building is caused by ignition of smoke. Many fires are first noticed by the sound of explosions, and these are often attributed to illuminating gas, even where the service does not exist.

We may also call attention to conditions in which certain substances will aid materially in causing effects that are seemingly inexplicable.

The chlorates and nitrates of potash and soda are used extensively in dyeing establishments as oxidizing agents, and while these substances may not be dangerous in themselves, it has been shown by experiment that the oxygen given off by these chemicals melted by heat, as in burning buildings, and coming in contact with the smoke from burning wood, or organic matter, will form a very explosive mixture, which will ignite at a very low temperature without the presence of flame.

Melted chlorates in contact with glowing sparks on charcoal or partly burned wood will cause an intense flame, owing to the excess of oxygen present.

These experiments are regarded as an explanation of the cause of a very serious explosion that was attributed to chlorate of potash during fire in a large drug warehouse in New York. It must, therefore, be evident that these substances stored in a warehouse constructed of combustible material, or where other combustibles are stored, are very dangerous. Chlorate of potash fuses at 750 degrees Fahrenheit and oxygen is given off at the rate of 543 cubic inches to one ounce of chlorate, or over a gallon and a half, and forms explosive mixtures with nearly all combustible bodies. With sulphur and charcoal it forms a compound that explodes by friction; with sulphur alone, it detonates powerfully when wrapped in paper and struck by a hammer; with phosphorus, slight compression results in a violent explosion; with sugar, as in the manufacture of medicinal tablets, the mixture will ignite if sufficiently heated in drying ovens, or if spilled on hot steam pipes, and a drop of sulphuric acid will cause the mixture instantly to inflame. Chlorate of potash mixed with organic dust on a floor will ignite by friction or concussion caused by moving packages about. Permanganate of potash and peroxide of manganese will also act in a similar manner as producers of oxygen, the latter chemical yielding seven gallons of oxygen to one pound of the substance.

EDITOR'S NOTE.—The question whether starch, flour or dextrine dust will explode, and how far such dusts are capable of transmitting explosions, has been the subject of experiment by Dr. R. V. Wheeler, the Chemist of the Explosions in the British Coal Mines Committee, at their Experimental Station at Eskmeals, and his recent report on this subject as quoted in *The Operative Miller* makes it clear that under certain conditions they are both explosive and capable of transmitting an explosive wave under conditions very similar to coal dust in coal mines. Dr. Wheeler found that samples of the three dusts named, when tested under the same circumstances and with the same apparatus as used for tests with coal dust, had relative ignition-temperatures of:—

Dextrine (calcined farina)	94° C.
Flour	960° C.
Starch	1,035° C.

while the ignition-temperature for the most bituminous coal dusts is given, for the purposes of comparison, as between 1,000° C. and 1,100° C.

Referring again to Dr. Wheeler's report, he says:—

It is necessary now to consider what is the exact significance of the relative "ignition-temperatures" obtained, and how far this determination affords a measure of the inflammability of the dust.

In case of the majority of the dusts tested, inflammable gases can be evolved from them by decomposition at quite low temperatures. If, therefore, any particular dust were allowed to remain in contact with a surface heated to, say 800° C., for a length of time sufficient to evolve inflammable gases in quantity capable of forming an inflammable mixture with the surrounding air, this mixture of gas and air should ignite, and it might, by its combustion, provide sufficient heat to cause the inflammation of an adjoining layer of dust and air. In this manner, propagation of inflammation should take place throughout the extent of the dust cloud. Given, therefore, an infinite time of contact between the particles and the source of heat, so that there is ample time for the destructive distillation of the dust, the temperature necessary for ignition should be approximately that of the inflammable gases evolved.

Dust Explosions in Grain Elevators.

A Suggestion for Their Prevention.

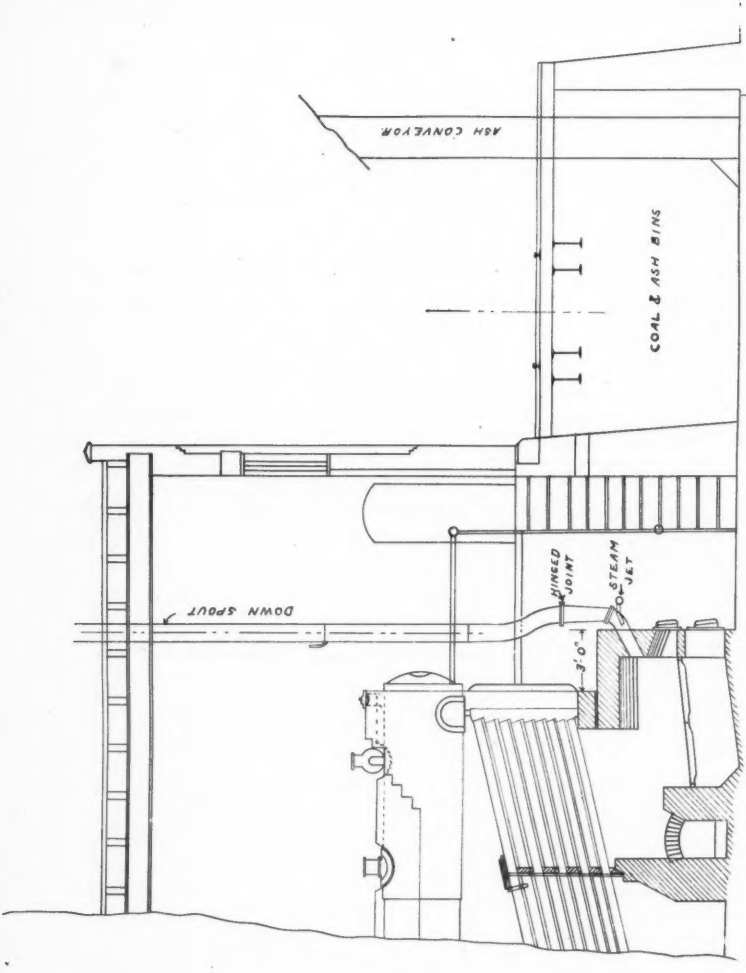
A number of years ago the Pennsylvania Railway Company had a series of explosions in the boiler furnaces receiving the discharge from a shavings collector system at one of its shops. After a careful investigation of the conditions by the Motive Power Department such explosions were eliminated by blowing the dust and refuse into the boiler furnaces by means of steam jets placed in the discharge pipes from the collector system and by extending the furnaces to improve the combustion of the refuse.

A recent dust explosion in one of the company's grain elevators, being investigated and reported upon by the Motive Power Department, resulted in the adoption of a similar agency for the elimination of this hazard from the elevator. The suggestion should be a valuable one for reducing the danger of explosions at all grain elevators where dust collector systems feed directly into the boilers.

We are indebted to our member Mr. R. H. Newbern of the Pennsylvania Company for a copy of the report of J. T. Wallis, General Superintendent of Motive Power, on the elevator dust explosion and the means adopted to prevent its repetition. Following is the report:—

We have had this matter carefully inquired into and reach the conclusion that the explosions are caused by flame from the boiler furnace leading into the down spout from the separator at the time when the boiler damper is closed or when the fan delivering dust from the elevator into the separator is stopped. A representative from this office talked with the engineer at the elevator and learned that the serious explosions have always occurred when the fan was being stopped, and the engineer has since arranged a code of signals between the elevator and the boiler room so as to give him warning when the fan is to be stopped and thus enable him to withdraw the dust spouts from the boiler furnace. The path from the furnace through the down spout, separator and vent pipe from the separator to the bottom of the stack forms a short circuit between the boiler furnace and the stack when the boiler dampers are closed. The draft in the stack is sufficient to reverse the direction of flow of dust through the down spout when the boiler dampers are closed and thus carry burning particles of chaff and dust into the down spout, causing ignition of dust in the down spout and separator and this dust, in the presence of air, burns with such rapidity as to cause an explosion.

The danger from explosion can be entirely eliminated by blowing the dust into the boiler furnace by means of steam jets placed near the bottom of the down spout, substantially as indicated in the accompanying sketch. The furnace condi-



Sketch showing application of steam jet to down spout feeding dust to boiler furnace.

tions can be further improved by reconstructing the boiler furnace so as to make a sort of Dutch oven extending in front of the boiler setting about three feet, with a fire brick arch covering this extended furnace.

We are of the opinion that the extension to the boiler furnace can be made without causing inconvenience in the handling of fuel or in the firing of the boilers. This change, however, will necessitate the rearrangement of the stairway into the boiler room, which we believe can be easily done, and we would suggest therefore

that the furnace be reconstructed substantially as indicated on print from sketch tracing herewith.

The coking or the ignition arch over the extended furnace should be placed at a height of not less than three feet above the dead center of the arch. The dust pipes should enter the extended furnace above the fire doors, in substantially the same position as at present.

The steam jets should be of the expanding nozzle type and should have a diameter at the throat of the nozzle of about 1-16 inch. Two such nozzles should be placed in each of the dust pipes. These nozzles will each pass a quantity of steam equivalent to about one half B. H. P. with full boiler pressure. If it is found that the velocity created by the steam jets is unnecessarily high it can be reduced by throttling the pressure to the nozzles.

In addition to these changes we would suggest that the main boiler damper be arranged with a stop to prevent the damper from being completely closed when the damper regulator operates to shut the damper. There will thus be less tendency of a flareback from the furnace in case there should be any stopping of the flow of dust through the down spout.

There is no necessity for constructing a large dust bin over the boiler room, in fact we would look upon this as involving additional risk from explosion, as the accumulation of dust in the storage bin would only need a spark or flame to cause ignition and explosion. The safety of operation depends upon continuously clearing the separators of the dust and uniformly moving this into the furnace.

Several years ago there were a number of fires in the shavings bin of the Altoona Car Shops Boiler Plant which were caused in substantially the same manner as these dust explosions occur. There was a bin located above the boilers for the collection and storage of shavings with down spouts leading from this bin to the boiler furnace. The main flue to the stack was provided with a damper regulator and it was found that when the damper regulator closed the damper, stopping the draft through the furnace, the draft in the down spout would reverse and lead the flame from the furnace into these down spouts, resulting in fire in the shavings bin. This trouble was stopped by placing steam jets at the bottom of the down spouts to blow the shavings into the furnace. Later the storage bin was removed and replaced by a separator so that the shavings were burned continuously as produced and there was no accumulation in a storage bin. The boiler furnaces were also reconstructed, extending the furnace to some ten or twelve feet long so as to get better combustion of the shavings.

EDITOR'S NOTE.—The Committee on Blower Systems of the N. F. P. A. after consideration of the above plan made the following comment: "It is recommended that the venting air pipe connected into the main boiler stack of the power plant be disconnected from the stack and that in place of the same a washing apparatus be installed for the purpose of removing the dust. On the other pipe which conveys the refuse to the fire boxes of the boilers an automatic damper should be installed as close to the boiler fire boxes as possible, so arranged that the damper shall automatically close the discharge pipe as soon as the blower in the grain elevator is stopped, thus preventing back draughts of the flame from the fire into the discharge pipe which may still contain some refuse or dust. We believe if these two recommendations are observed further explosions will be prevented."

Celluloid: Its Use in Shoe Factories.

(*a*) By E. H. Bartlett, (*b*) by H. P. Bruce (Members N. F. P. A.)

(*a*)

CELLULOID BOX TOES AND COUNTERS.

Of late many shoe manufacturers have been using pyroxylin plastic, generally known as celluloid, on an extensive scale. The celluloid is used in the shoes, both in the form of counters and box toes. The use of these counters introduces no great increase of the fire hazard, but the use of celluloid in making box toes increases the ordinary shoe shop hazard materially.

Counters. In the celluloid counter the celluloid is reinforced on the outside by a small piece of sole leather to give stiffness, and then the whole is covered by a single piece of thin sheepskin covering both sides of the counter, and completely covering and concealing the celluloid. This method of making counters was invented and patented by Mr. G. H. Preble of Lynn, Mass., who sold the manufacturing rights to a Haverhill concern on a royalty basis.

The cost of these counters at present is the same as that of the highest grade of sole leather counters, so that there is no money saved by their use, and their introduction on a large scale in shoe factories is unlikely. Some manufacturers are using them exclusively in all their pumps and oxfords, as they claim that they are entirely proof against the softening effects of perspiration. These celluloid counters come from Haverhill, being brought ready made, and as the celluloid is completely covered by leather they present practically no fire hazard.

Box Toes. The use of celluloid in box toes is a matter of no small importance. The celluloid is bought in sheets measuring 20 x 50 inches and 15-1000 inch in thickness, weighing about one pound to the sheet, and comes well crated in strong wooden boxes. The following description covers the conditions found in one factory which probably represents the typical method of using the celluloid. The cutting of tips or boxes from the celluloid sheets is done in the cutting room, where the boxes are cut in lots of 2,000 pairs and tied into bundles of 100 pairs each. The lasters of this factory work in "gangs" of three men each, each "gang" having at its bench a supply of five different sizes of boxes. As there

are ten "gangs" and as each hundred pair bundle weighs about a pound and a quarter, it follows that there is 60-65 pounds of celluloid on the laster's benches at one time.

There was also a main supply of celluloid in the lasting room in the form of 100 pair bundles, contained in five half bushel boxes and which would possibly amount altogether to 100 pounds or more, making the total amount in the lasting room 160-165 pounds.

Before the celluloid boxes are used it is necessary to soften them by immersing in a solvent. Originally wood alcohol was used for this purpose, but on account of objections made by the men, some factories gave it up and are at present using a mixture consisting of about 70 per cent of denatured alcohol and 30 per cent of acetone, to which is added ¼ to ½ per cent of oil of citronella, the latter ingredient being introduced only for the purpose of improving the odor of the mixture. This liquid is used from open tin boxes holding one quart each. The celluloid tips are suspended in this liquid for a few minutes by special hangers, after which they are inserted in the shoe, which is immediately lasted. The lasting is done cold, no heat being used.

It is not possible to use this process on turn shoes, but it is said to be a great success on welt and McKay shoes. It produces a toe easily lasted, which is light, flexible, uniform and perspiration-proof.

The process is said to have been invented by Mr. F. H. Thompson and Mr. F. H. Preble of Lynn, Mass. On account of the opposition of the labor union, the process is not being used in many factories but the inventors expect that it will come into general use as soon as some arrangement can be made with the unions. Celluloid "boxes" are being cut and sold at the present time by the Preble Box Toe Co. of Lynn and shipped to various factories outside of Lynn.

Suggestions. The introduction of the process should call for the disuse of gas on account of the increased hazard. Electric lights should be installed in its stead. Ventilators are needed to take off the fumes from the alcohol. The boxes containing the solvent should be kept covered when not in use.

The celluloid, both that at the workmen's benches, and the main supply of cut stock, is not usually covered. The supply at the benches should be kept in deep tin boxes with hinged covers, these to be kept closed at all times when not in use. The main supply should be stored outside the factory in strong metal boxes or fireproof vaults, only that quantity necessary for the daily output being brought inside. This latter supply should be kept in tight metal boxes with self-closing covers. Not over 250 pounds of uncut stock should be allowed in main buildings.

These celluloid toe boxes are cheaper than the best grades of sole leather boxes, but are more expensive than the cheaper kinds used in low grades of shoes. From all that can be learned it seems probable that this process will before long be used extensively by makers of high grade shoes.

(*b*)

CELLULOID-COVERED WOOD HEELS.

The wood heel industry has taken such rapid strides in the last few years that it now plays a most important part in the shoe industry, especially in the manufacture of ladies' shoes.

The principal advantage of the wood heel over the leather heel is that while it is very difficult to fasten the lifts on some shapes of leather heels it is a simple matter to obtain any shape desired from a block of wood.

Shoe factories using wood heels can be divided into three classes:—

(1) Those making the complete heel,—this class includes some of the largest factories.

(2) Those buying the wood heel and doing the covering themselves.

(3) Those buying the covered heel already made, as in the smaller factory.

The first class includes factories making the complete heel and covering it.

The wood with which these heels are made is almost always of maple. This wood is bought in planks and sawed into strips wide enough for the desired heel model, the strips being then sawed into pieces about two inches long. These blocks are then shaped on a moulding machine to the desired size and shape. They are treated with a thin solution of lacquer and are then ready for the celluloid coating.

This celluloid, which is a very cheap grade, comes in sheets about 20 x 50 inches and from 10-1000 to 15-1000 inches thick, a sheet weighing about nine ounces. From four to six of these sheets are fastened together and are cut with dies to the desired shape for covering the heels. Covers for about three pairs can be cut to the square foot. Some concerns cut up a day's supply while others cut them as needed. The covers are sent to the cementing room to be softened and applied.

Softening is done in two ways: first by what is termed the cold process and second by the hot process.

The cold, or immersion process, consists of soaking the cover in a dish containing about a quart of solution made up mostly of wood alcohol with a small amount of acetone. The covers remain from one to six hours in this and they are then plastic enough to stretch around the heel. The heel is held in what is known as a "Jack" which holds the heel on the top and bottom, the cover is stretched around the heel and cemented together at the breast with a heavy amyl acetate lacquer. The "Jack" is then removed and the cover is turned over the top and bottom of the heel, trimmed and cemented at the edges. The heel is now ready for finishing. A bottom lift of leather is fastened to the heel with a screw in the center, and with nails. The heel is then polished on a cloth buffing wheel with "Tripoli" polish, which gives it a smooth surface. The heel is now ready to be fastened to the shoe.

The hot or vapor process consists of softening the cover by means of

the vapor given off when a mixture of wood alcohol and acetone is heated slightly. This heating is done in a wooden oven lined with hair felt and metal. The liquid is placed in a pan in the bottom of the oven which is placed over a steam pipe. The covers are placed on a wire shelf above the liquid. The oven is tight except for the cover on top or door on the front for putting in and taking out the covers. The covers are allowed to remain in the vapor, the temperature of which is between 80 to 100 degrees Fahr. from four to five minutes.

These ovens are about 2 x 2 feet x 1 foot high and one operative has two ovens to attend. The cover or door to these ovens should have springs so as to close automatically and keep the vapor from escaping. From here on the process is the same as in the previous method.

The second class of risks includes those who buy the wood heels and do the coating themselves. In this class the woodworking hazard is eliminated but the celluloid hazard remains.

The third class of risks is those which purchase the wood heels already covered and the hazard is only that due to the presence of the celluloid heels, which is small, as these heels will barely burn.

Hazards. The woodworking hazard is the same as any woodworker, and a blower system should be connected to each machine to remove the sawdust and shavings to a good, safe shaving bin.

In cutting the celluloid there is a hazard in the celluloid and in the waste from it. Care should be taken to clean up all the scrap celluloid and have it removed from the building as soon as possible. There should not be more than 250 pounds of celluloid in the building at one time. The sheet celluloid and cut covers should be kept in a metal box with a metal cover when not in use and the main supply should be kept outside in a detached shed.

The main supply of liquids used as softeners should be stored outside and that in the dishes and ovens removed every night. The room in which this softening is done should be shut off in a good manner. There should be no open flames in the room, and if artificial light is used it should be incandescent electric with double globe, vaporproof lamps with keyless sockets. The room should also be ventilated to the outside of the building.

Retouching. In most shoe factories a solution is used to retouch any damage done the uppers while the shoe was being made. Most of these solutions are made up of celluloid in solution with some solvent.

This solution is put on the damaged part with a brush and after drying is buffed or rubbed up.

The retouching solutions come in small bottles holding about half a pint and each operative may have from six to eight of these bottles on his bench.

Practically the only hazard in conducting this work is that of an open flame coming in contact with the gases given off.

Shoe forms. Although this class of work will probably not be found in shoe shops it is worthy of mention.

These shoe forms are used for show purposes such as in salesmen samples and in shoes in store windows.

The forms are made of either light wood, fibreboard or pasteboard. The old way was to paint or stain them for a finish and as the call was for a better finish, pyroxylin plastic was tried with good success.

There are two ways of coating the form with this. One is to cover the form with the sheet celluloid and the other to apply the coating by means of a spray. The first method, that of applying the sheet celluloid, is similar to that used in coating wood heels. The second, that of applying the coating by means of a spray, is much more hazardous.

In the risk visited the spray is applied as follows. The liquid, which is celluloid and acetone, is purchased in cans and is poured into the sprayer as needed. The container on these sprayers holds about one quart. The air pressure is supplied by an air pump.

The shoe form is held by a wire under a metal hood with a fan which conducts the air and gas to the outside. One coat of this spray is given the form and it is then sanded down and two more coats applied. The finish is obtained by buffing as in wood heels. As the solution comes in any color, any shade can be matched. By this method a coating of celluloid about 10-1000 inch is obtained.

This process should be done in a well cut-off room which is provided with suction fans to carry the vapors to the outside. No open flames should be allowed inside the room and the light should be incandescent electric in double vaporproof globes with keyless sockets. The storage of the solution should be guarded as are other highly inflammable liquids.

The Protection of Sprinkler Risers against Freezing.

By Benjamin Richards (Member N. F. P. A.)

In buildings without heated basements, sprinkler risers and other fire service pipes are very frequently exposed to freezing under the first floor of the building. Many buildings are set up on posts one to five feet above the ground. Fire service pipes which pass from the street or yard main, below the frost line, rise up into the building through the exposed, unheated space, sometimes entirely unprotected and usually with inadequate protection from freezing.

In New England it is customary to bury pipes four to six feet underground to insure their being safely below frost. It is therefore essential that the equivalent of this protection by burying be provided on all pipes passing upward through ground subject to freezing and the space between the ground and the heated room above.

Heretofore a common method of protecting such pipes has been to enclose them in wooden boxing with either a single or a double air space. Sometimes the boxing is filled with tan-bark, sawdust or other insulating material.

These boxings are in general defective and inadequate. They seldom are carried down into the ground four to five feet below the surface, as they should be, and do not pass upward entirely through the floor, but end on the lower side of the floor boards, thereby leaving a crack through which cold air enters the boxing.

The decay of the boards, settling, vibration of the building and the swelling and contraction due to successive moisture and dryness all tend to make the maintenance of a tight boxing and a dead air space practically impossible. While a strictly dead air space is an ideal insulator, any crack which permits the air to circulate in the least degree impairs the protection materially.

Frequently these spaces under buildings are assumed to be warmed from steam heating returns or other source of heat, but experience has shown that full protection of the fire service pipes is essential even in such places, as there are often times when repairs to steam pipes or repairs which necessitate openings in the outer walls during cold weather cause the pipes to be fully exposed to the cold.

Sprinkler risers often pass up too near the outer wall or windows. In wooden buildings freezing is possible in such cases, and as windows may be left open carelessly, all such pipes should be protected by steam pipe lagging or its equivalent.

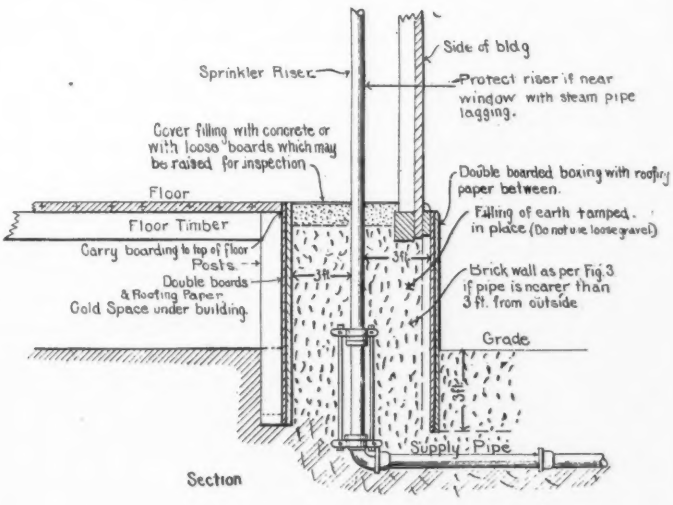

Side of bldg
Sprinkler Riser
Protect riser if near window with steam pipe lagging.
Cover filling with concrete or with loose boards which may be raised for inspection
Double boarded boxing with roofing paper between.
Floor
Filling of earth tamped in place (Do not use loose gravel)
Floor Timber
Carry boarding to top of floor
Posts
3ft
3ft
Double boards & Roofing Paper
Cold Space under building.
Brick wall as per Fig. 3 if pipe is nearer than 3 ft. from outside
Grade
3ft
Supply Pipe
Section

Figure 1.

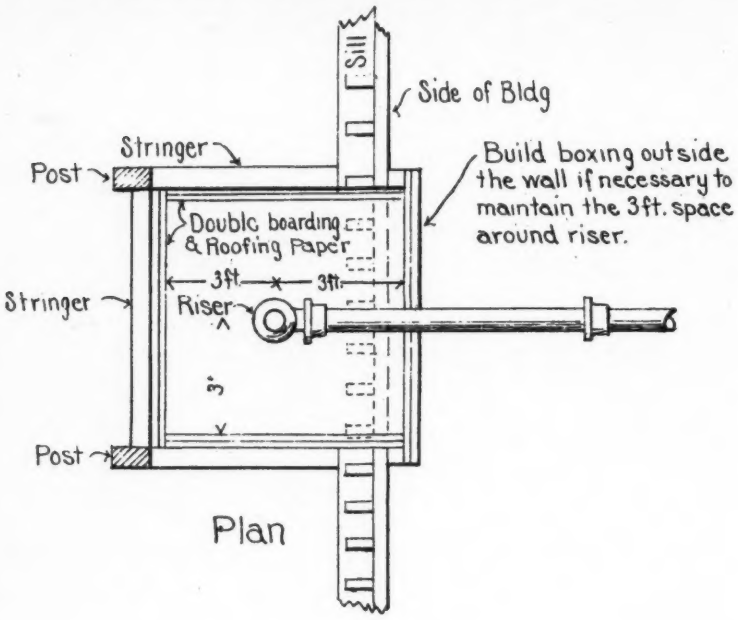


Figure 2.

Suggestions.

The following sketches show the methods recommended for safeguarding pipes under buildings.

Figures 1 and 2 show an inexpensive method of protecting a pipe entering a wooden building where the first floor is two or three feet above the grade.

There is a double matched board boxing, with roofing paper between the boards, extending from a point three feet underground to the upper surface of the floor. If a crack develops where the boxing joins the floor, the cold air passes up into the room rather than into the boxing. This feature is important.

The boarding is double to insure strength and tightness. It is securely nailed to upright posts. The life of the boxing can be greatly prolonged by kyanizing the wood or painting it with creosote.

The boxing should be of such size as to permit not less than a three-foot space around the pipe. In localities where frost goes to an unusual depth the boxing should be larger.

It will usually be necessary, in order to procure the necessary space around the pipe, to build out the side of the building slightly as shown. In this case special care is necessary to make tight joints where the boxing

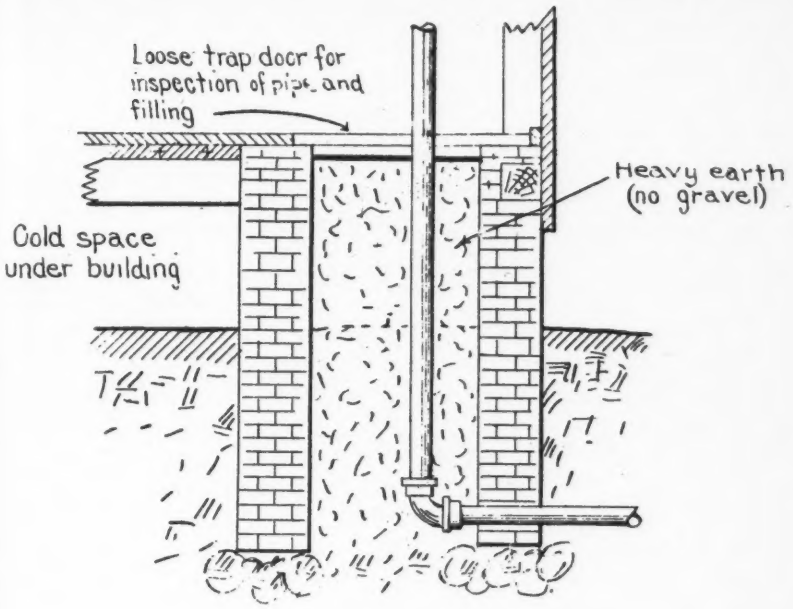


Figure 3.

joins the building. This outer wall should have the additional protection of shingles or clapboard.

The boxing should be entirely filled with a heavy earth. Ground cork, sawdust, tan-bark, etc., may be used, but these materials are subject to more or less decay and to settling and are not considered better than earth. Avoid the use of ashes, loose gravel or other open material through which air may pass. The filling should be well tamped down.

The boxing over the filling should be cemented over or provided with a trap door or loose boards so that the filling can be readily inspected from the room to note any settlement of the filling or breaking away of the boxing.

In cases where the building is built up to the property line and the boxing cannot be extended beyond the wall line of the building, to get the necessary size, the outer wall should be replaced with brick, as shown in Figure 3.

Figure 3 shows a more substantial and permanent structure, brick being substituted for the boards. In this case the enclosure may be smaller, as the brick walls are much better protection than the boards.

Note that the brick work extends from below the frost line to the top flooring. The trap door, resting directly on the top of the brick walls, is provided for inspection of the filling as in the former case.

Drain Pipes.

Drain, drip or draw-off pipes should never terminate in blind spaces under the buildings. The water from these washes the soil away, exposing the pipe and may undermine the structure protecting the pipe.

Cold air enters draw-off pipes and may cause freezing of the valves. Cold air has been known to enter drain pipes from retarding chambers of alarm valves sufficiently to cause trouble by freezing in the alarm check valve.

All drips should have at least four feet of pipe exposed in the warm room. Where it is necessary to drain alarm valves outside the wall, an open discharge cone should be provided inside to break the pipe line so cold will not be conducted directly into the retarding chamber.

Restoring Impaired Automatic Sprinkler Protection in Montreal.

By "C. F. U. A.," Montreal (Member N. F. P. A.)

The fact that in extremely cold weather some of the automatic sprinkler systems in Montreal were adversely affected by the frost, causing them to be shut off for greater or less periods, led the Canadian Fire Underwriters' Association some years ago to adopt a means of prompt notification when such trouble occurred, even at other than business hours. The desired result was to have the protection promptly restored; or at least to secure a watchman's service in the interim. The same notification was desirable whenever a fire occurred in a sprinklered property or where an exposure fire threatened.

To this end, the Association advised the Central Station operating the alarm connections to immediately notify them of any trouble of which they were aware. Telephones were installed in the residences of several of the sprinkler inspectors of the Association, with the understanding that they would respond to calls at other than regular business hours. The Central Station offered to co-operate in the matter and a supply of plugs, wrenches, etc., supplementing the sprinkler heads already carried, —was furnished them by the Association. The Montreal Fire Department volunteered to help, and the salvage corps, which is under municipal control, now carry a supply of sprinkler heads given by the Underwriters. Two complete outfits of rubber clothing, including hat and boots, similar to the Montreal Fire Department uniform, were purchased by the Underwriters and are kept at the office of the Central Station for the use of the sprinkler inspectors of the Association. The practice has been for the Central Station, during other than business hours, to call up by tele-

phone at the residence, either the head or one of the inspectors of the sprinklered risk department, advising of trouble with a sprinkler equipment, or of a fire in a sprinklered risk or nearby. In case of frost, where only a few sprinkler heads are involved, the Central Station replaces the same; or if a small pipe is split by the frost, takes out the pipe and inserts a plug, leaving a few sprinklers disconnected, but restoring the balance of the protection, and advising by telephone to this effect. In case of serious trouble, they may ask for the assistance of an inspector, or if the break is too large to be repaired except by a regular contractor, a watchman is left, the assured notified, and arrangements made for repairs as soon as possible by the regular sprinkler contractors, who can also be reached by telephone at their residences.

The trouble has largely been with sprinkler equipments "of the first year"; that is, where they have not been through a winter; for notwithstanding cold weather bulletins and other precautionary circulars, apparently some property owners have to learn by actual experience that it is better to properly heat buildings during cold spells than to pay for repairs to the fire protective apparatus. The majority of the calls come with the first severely cold weather, during the latter part of December or early January. The winter of 1911-12 was quite severe, with a number of appeals, there being nine sprinkler equipments restored over one week end in January, 1912, the greatest number taken care of at any one time. That of 1912-13 was a mild one and there were very few such calls.

The mercantile risks without regular watchman's service, but connected with a Central Station by either water flow signal or supervisory system, are naturally the ones most easily followed up under the above arrangement, yet in a number of other cases the owners have telephoned direct. A mercantile risk is the one with the least resources of its own to fall back on in case of trouble, but in all classes of risk the owners are encouraged to appeal to the Underwriters for assistance.

While the intent is to use the inspectors only in case of urgent necessity (since they cannot be expected to work both day and night for any continued period), some of the inspectors have cheerfully put in long extra hours in such work. During the last six years, since the system was inaugurated, a number of impaired sprinkler equipments have been promptly restored in this manner. Some of the inspectors are enthusiastic in the work, especially in responding to fire alarms. With the growth in the use of automatic sprinklers some means will have to be developed for extending this work, for the maintenance of the automatic protection is so vital a thing in a sprinklered risk that no one having responsibility will be disposed to allow systems to be shut off over night or over week ends, if it can be avoided.

While the above described methods apply particularly to the Montreal office of the Canadian Underwriters Association, similar supervision is maintained by the Toronto office, and good work has been done by the inspectors there also.

Courtesy *Pittsburgh Chronicle-Telegraph.*

St. Agnes Church, Pittsburgh, Pa.

Department of Fire Record.

Every period of extreme cold is accompanied by a large number of disastrous fires due to forcing the heating apparatus. This is particularly true of churches, which are difficult to maintain at a temperature satisfactory to the requirements of people who have to sit still for any length of time. Unfortunately the heating apparatus is often left to take care of itself after the evening service is over, and consequently a fire breaking out because of this fact has an opportunity to gain considerable headway before discovery. Although many churches have stone walls, the interior is more often of wooden construction and a fire once started in this large auditorium is very difficult to extinguish without large loss.

The two photographs in this QUARTERLY illustrate very clearly the complete destruction of these churches.

Second Universalist Church, Columbus Avenue, Boston.

GENERAL FIRE RECORD.

Unsatisfactory or Serious Fires in Buildings Equipped with Sprinklers.

Where sprinklers fail the cause is, almost invariably, clear. These fires are selected to indicate such causes, that they may be generally understood and satisfactorily met.

S-15490. Buildings where fire occurred were grouped together east of the main plant and consisted of a brick shavings vault, brick boiler room, one-story frame and brick engine room and two two-story brick dry kilns. Buildings were cut off from one another, except engine and boiler rooms which were only partially cut off. Engine room was of frame and brick with tar and gravel finished plank roof on 3 x 11 inch joists. Engine room adjoined boiler room and was partially cut off by a twelve-inch brick party wall.

Fire originated in low space of boiler room between brick arch and joist roof. The exact cause could not be ascertained but from information gathered from employees it would seem that dust in space ignited from some cause, resulting in an explosion. It was stated by employees that when fire was first noticed it had worked through frame wall of engine room and through roof of boiler room and seemed to follow a muffled explosion. At that time sprinklers were operating but smoke was so thick in engine room that it was found impossible to enter. A small window at side was broken and hose trained through opening. It was immediately after hose was brought into play that main belt, becoming wet by water from sprinklers, worked from fly wheel and engine began to race. Governor failed to operate and fly wheel of engine burst, the flying pieces tearing out frame end of engine room, large portion of end of shavings vault, and also breaking pipes on ceiling and entered main building near cornice. The fire itself was readily extinguished by the fire department which reached the property shortly after the fly wheel burst.

S-15277. This fire occurred in a large plant manufacturing a pyroxylin plastic known as fibreloid, which is a patented trade name for an article commonly known as celluloid. Plant consists of twenty-five distinct sprinklered buildings, basement, one and two stories in height and mostly of mill construction. All buildings are well detached. Eighteen of them are comparatively of small size, while seven contain, in all, thirty-one distinct cut-off fire sections.

Sprinkler systems are supplied through suitable connections from an eight and ten inch yard loop having an eight-inch connection with a thirty-inch high service waterworks main, pressure 105 pounds. Secondary supply consists of a 1,000-gallon Underwriters steam fire pump.

The fire originated in the solvent building, a one story and basement brick building of mill construction, forty-two by forty-two feet area. This building was used for the recovery of camphor from scrap fibreloid and contained two machines especially designed for this purpose. This process consists of treating scrap with caustic soda and extracting the liberated celluloid. There was always more or less storage of scrap in wooden boxes packed on first floor and in basement. The first notification of fire came from the electric annunciator connected with alarm valves. Engineer promptly notified the fire department which started the pumps. Building was found to be burning fiercely, flames shooting high into the air, as is typical for this class of material. Two streams were taken from pump and the fire department also laid two streams. Attention was directed to the exposed buildings. Sprinklers in first story, about twenty in number, all opened but apparently had very little effect upon the fire, due to the extreme hazard of the contents. There were twenty-three sprinkler heads in the basement, only eleven of which opened. Very little fire took place in this basement, fire being most vigorous on the south side of the first floor where it appeared to have originated. Sprinklers in the other buildings materially aided in preventing fire from entering them.

Although there was no manifestation whatever of an explosion, three walls of the solvent-building fell outward about half an hour after the start of the fire. The cause of this seems to have been the same which has been assigned to other fires of this character, namely, that the heat and gases from the combustion of a large quantity of this material will destroy brick or concrete work as the intense heat, quickly applied, causes unequal and excessive expansion, resulting in failure of the structure. This should be accepted as one of the characteristics of the combustion of large quantities of pyroxylin plastic materials.

The actual cause of the fire is impossible to determine, several theories being advanced, the most likely of which is that there was some foreign material contained in this scrap which may have started the fire.

Conclusions.

(1). In planning protection against this hazard, the great intensity of the fire over that of an ordinary fire should be thoroughly considered.

(2). The sprinkler equipment should be planned on the assumption that considerable of the water will be evaporated by the excessive heat.

(3). On account of the great amount of heat radiated from this burning celluloid, whether in a fireproof vault or not, it is imperative that it should be stored a distance of at least fifty feet from surrounding buildings.

(4). It is desirable to keep the amount of material subject to one fire to five tons or less. If large quantities must be kept on hand, they should

be divided into small amounts and stored in separate fire sections, preferably separate buildings.

S-15405. Fire originated from unknown cause. Supposed origin at a gas heated crimping machine on premises of a braiding and embroidering company, fourth floor, due to defective rubber gas connection which may have become disconnected as result of heat generated by machine left burning. End of rubber tube when burned off may have fallen to floor, igniting floor boards and spreading fire to joist channels beneath, where fire spread after sprinklers operated.

Alarm was received at A. D. T. central station at 10.08 p. m., at which time insurance patrol was notified and left quarters for the premises. Fire was not discovered promptly when patrol arrived because entrance to floors above first floor appeared to be in adjoining building. Patrolmen, by going down front and rear fire escapes, finally located the fire. At 10.10 p. m. A. D. T. received supervisory signal for system gate closed. This valve was closed about time patrol arrived on premises by watchman in basement and was immediately opened by him when he observed the patrolmen. This watchman admitted to the captain of the patrol that he had not investigated the cause of the alarm and that he did not realize it may have been caused by a fire. When he saw the patrolmen he realized that a fire might be located in the building and he immediately opened the valve. No signal was received at A. D. T. central station for the reopening of this valve, perhaps because valve was not opened wide. Upon discovery of fire by captain of the patrol, a city fire alarm box was pulled (10.40 p. m.) which brought the fire department. The fire department pulled the plastering off the ceiling over an area ten by sixty feet in the third floor and found that the fire had spread in three joist channels across three girder bays (joist spans). The two sprinkler heads which opened were located on the fourth floor directly above supposed origin of fire, and all fire in the fourth floor was extinguished by them.

The reason for the spread of fire to more than one joist channel was because plaster and lath finish on ceilings in this building is attached to nailing strips instead of being attached direct to joist. The loss, except to building, is mostly result of water damage.

Watchmen should be thoroughly instructed regarding sprinkler system, before being allowed to act in that capacity.

S-15483. This fire of unknown cause, in a broom factory, originated in basement near open elevator shaft of a four-story brick building having joist floors and unprotected floor openings. Watchman on premises claimed he heard water running and went to basement and saw head in operation, but that he saw no smoke nor evidence of fire, and then claims he went to top story and closed both tank valves. From top story he went to basement and claims to have closed system valve and opened drain valves; then telephoned for fire insurance patrol, after which he found that there was so much fire in the building that he could not open the valves he had closed.

Building and contents were practically destroyed, resulting in a loss of approximately $50,000.

This fire again illustrates the necessity of having capable watchmen.

Summary: **Sprinkler system shut off and especially inflammable contents.**

S–15439. Fire was probably caused by sparks from a nearby foundry igniting shingle roof over dormer window. Attic was not equipped with sprinklers although floor below, occupied as pattern shop, did have sprinklers. Fire department kept fire confined to attic and part of floor below. It was reported that the old Fowler sprinklers held fire in check on floor below, but only one head was found open and its seat was stuck closed. Loss $8,697.

Summary: **Unsprinklered portions and defective sprinklers.**

S–15538. This building, seven stories in height, brick walls, open finish, floors of plank and timber construction, was equipped throughout with automatic sprinklers and occupied by several tenant manufacturers.

The fire evidently started in the sixth floor from unknown cause in the space boarded over and used for a coat room by the men and women. The sprinklers did not fully extinguish the fire in this coat room. Twenty heads opened on this floor. Fire spread up through hole in floor around pipes to the seventh story. The sprinklers on the seventh floor did not appear to open, as fire seemed to spread unchecked. In the meantime the watchman had discovered fire and had turned in the alarm.

In part of the seventh floor an examination of the sprinklers found in the debris and on pipes indicated that they had been frozen. These sprinklers and pipes on the top floor contained ice, and water was not discharged until heat was sufficient to melt the ice. By this time all sprinklers were opened on this floor.

The actual damage by fire was practically confined to the two upper floors, although all sections of the building were heavily soaked with water which ran down through fire door openings into all floors. The weather was so cold this water froze and prevented prompt removal of the same.

Conclusions.

This sprinkler failure was primarily due to the insufficient heating of the building, care not being taken to take extra precautions during a period of unusually cold weather. Obstructions to distribution, together with frozen sprinklers, allowed the fire to spread, opening a large number of sprinklers and necessitating the use of many hose streams to control the fire. The whole building was consequently thoroughly soaked with water which flowed through fire door openings into all sections. Because of the nature of the contents, this water damage was very large, loss being estimated at over $200,000.

Fires in Which There Was Loss of Life.

These fires are intended to point out conditions under which loss of life occurs, that they may be known and guarded against.

Holocausts which are adequately reported in the daily press or are the subject of special investigation may not be given herein; nor is any complete record of loss of life in fires at present obtainable.

Fires Involving Loss of Life.

A thirteen year old boy attempted to start a fire in a stove by **using kerosene oil,** when an explosion set his clothes afire. In his frantic rush among relatives for assistance, he communicated the flames to nine other people. Six, including the boy, died from their burns.

H-9651. Five men lost their lives at a fire in the Gus Kern Hotel in Newark, Ohio, on January 6, 1914. This flimsily constructed frame building, with one narrow stairway and winding passages, was used as a restaurant on the ground floor and a lodging house on the second floor. The fire was supposed to have started from a gas-fired warming oven in the restaurant which communicated to the wood sheathed wall. The men sleeping in the floor above were bewildered by the smoke and were suffocated or burned to death before they could find their way to safety.

H-9605. During a storm it appears that the high tension or primary current (about 2300 volts) in some manner became impressed on one of the low tension or secondary circuits of the local lighting company and entered several buildings connected with these wires. In this particular property the service wires extended from pole line to insulators carried on brackets attached to metal-clad wall of building. The current established an arc over a space of about two inches between the service bracket and the metal wall and also where it left the lower edge of the metal wall and passed to earth through the rain-soaked foundations of the building. The arcing attracted the attention of the occupants and severe shocks were sustained in attempting to extinguish the flame with water. One person placing his hand on the metal wall was instantly killed. The high tension current was cut off and the burning woodwork was easily extinguished with slight loss to the building.

S-15362. A batch of 1,000 pounds of mixed black dyed wool, twenty-five per cent cotton roving waste, and seventy-five per cent Egyptian cotton comber waste had been passed through the mixing picker into the gauze room probably before the fan was stopped. A slight explosion or puff occurred in the gauze room throwing the door open and sending a blast of fire out onto two men who had been feeding the picker. Both were fatally burned. Eight sprinklers, seven in the picker room and one in the gauze

room, opened. The amount of burning was very slight being confined almost entirely to the stock in the gauze room. A wooden partition about fifteen feet from the door of the gauze room was somewhat scorched. The room itself was vented into the picker room through coarse netting around the top.

The stock had been oiled with seven per cent of a saponified red oil and seven per cent of another oil which is understood to contain more or less lanoline. Neither of these appeared to contain any exceptionally volatile constituents.

Missouri Athletic Club Fire.

Another terrible holocaust was added to the many which have taken place in this country when thirty lives were lost in the fire which destroyed the Missouri Athletic Club Building at Washington Avenue and Fourth Street, St. Louis, on March 8, 1914.

The building, which had an area of 115 by 150 feet, was seven stories in height with brick walls. There was one stairway and three elevators through all floors in brick shafts which were not cut off. One fire escape was attached to the east wall of the building; while the other fire escape, enclosed in metal with metal sash and wired glass windows, was attached to the south wall.

The Club occupied the entire building except part of the first floor, in which was located the Boatmen's bank. The Club used the first floor for lobbies and reception rooms, the second floor for pool and billiard rooms, the third floor for dining rooms and kitchens, the fourth floor for dancing rooms and officials' headquarters, the fifth and sixth floors for sleeping rooms, and the seventh floor for a gymnasium.

The first alarm was turned in at 1.58 a. m. by the night watchman at the bank, who discovered the flames as he was coming up from the basement. Several explosions took place and increased the rapidity with which the flames spread. These were thought to have been caused by gas. The guests were first awakened by the ringing of the telephones in their rooms and the cries of fire called by the night clerk.

Some of the guests on the fifth and sixth floors, who had apparently found their way to the fire escape cut off, rushed into sleeping rooms on the west side of the building and leaped from the windows to the adjoining four-story building occupied by the St. Louis Seed Company. Many were injured in this manner. A number of bodies were located close to the windows on the third and fourth floors which showed that they had endeavored to reach the fire escape which was located directly in front of the Club windows in the Washington Avenue side.

This fire adds one more to the long list where buildings of this character have burned with fatal results which could, unquestionably, have been prevented if a properly maintained automatic sprinkler system had been installed. The open elevators, poor fire escapes and similar features aided in the spread of flames and failed, as usual, in their function of providing a safe means of egress.

Points of Interest from Fire Reports.

These notes are intended to illustrate the efficiency or inefficiency of signaling, retardant or extinguishing agencies.

Automatic Sprinklers.

S–15393. This factory has two core baking ovens each approximately eight by eight feet square and built of iron, brick and cement. These ovens are well constructed and are practically fireproof, each oven being equipped with a heavy iron door. They are heated by crude oil with air blast, tanks for oil being buried outside, and under air pressure of twenty pounds when ovens are in use. The air pressure for main air blast mixing with oil at burner is about three pounds. There is a brick pit in front of the ovens which extends into each oven where the oil burner is located. The whole system is very well arranged but apparently something went wrong with the oil burner and the pit was filled with oil which became ignited. All the air in this locality seemed to be on fire which swept through this section of the building.

First line of five sprinklers in this room all opened and held the fire in check. Much to the surprise of everyone, the light unprotected steel truss-work supporting roof in the foundry was not injured, this good fortune being attributed to the height of roof from floor, it being thirty feet to eaves and about thirty-five to forty feet in center.

S–15443. This fire occurred in a cotton mill of mill construction, and started on the floor of the opening room near the bale opening machine, probably caused by the attendant of the bale machine stepping on a match. The fire immediately spread into all the bins (the sides of the bins being slatted) opening nineteen sprinklers. The attendant failed to stop the machine when fire started, and, as the stock from this machine is exhausted into the third story of the picker house, the fire was drawn into this room, passing through the condenser and dropping from the apron carrier onto the lattice carrier. Eight sprinklers, including the one in the condenser, opened in this room and held fire in check until extinguished by hose streams.

S–15470. An electric flat iron had recently been installed to smooth out linings. As this was an experiment no pilot light was installed. A

good rest had been provided which, it is claimed, operator did not use but left iron on a wooden bench with current on. Two sprinklers opened and practically extinguished fire. Watchman did not understand sprinkler gate valves and could only shut off city supply, allowing water from gravity tank to flow for about twenty minutes, when the master mechanic arrived and shut it off. The large loss of $5,000 was due to water damage to stock of shoes.

Watchman should be thoroughly instructed in the use and operation of automatic sprinkler systems.

S–15249. An employee was experimenting with celluloid, preparatory to manufacturing buttons. While sheets of this material were being softened in hot water, the gas stove used for heating the water ignited several other sheets nearby on a table. Three sprinklers promptly opened and entirely extinguished the fire.

The automatic sprinkler is especially valuable in factories using such highly inflammable material.

S–15474. Fire started from unknown cause in varnish or oil storeroom located on fourth floor of building. At the time of fire this room contained several barrels of dry paint, five gallons of benzol in sealed cans, three gallons of alcohol, and several one-gallon cans of varnish. The fire department could not bring their apparatus nearer than half a block, because both streets were closed for repairs. This condition would have been a very serious handicap to the firemen if the fire had gotten beyond control of sprinklers. Fortunately when the firemen arrived they found the fire practically extinguished by the three sprinklers which had opened.

S–15417. In this coffin factory the plant is closed at 3.30 p. m. on Saturdays, and all rubbing rags and rubbish were put into a wooden barrel at small entryway to bridge on second floor. The boy who acted as helper was supposed to carry contents of barrel to boiler room before leaving factory. This day he forgot to do so. About 6.30 the superintendent heard the sprinkler alarm ringing and he immediately ran to factory and tried to enter the building through the bridge mentioned above. Upon opening the door at end of bridge he was met with a flood of water. The door was opened sufficiently to see that there was no fire, and the water was then turned off. It was found that the fire had not burned beyond the barrel in which it started. A time clock almost directly over the barrel was not even scorched.

This is a very good example of the efficiency of automatic sprinklers, illustrating the prompt manner in which fire is discovered through the sprinkler alarm and equally prompt extinguishment of the fire by opening of one head.

Rubbing rags and similar material should always be placed in metal containers.

S–15432. Fire occurred on the second floor of brick building on Sunday at 5.30 p. m. and was probably caused by spontaneous combustion of a cotton twine floor mop which was saturated with a floor oil said to be a mixture of linseed oil, turpentine and a little dryer. Floors had been oiled the day before and the mop was left standing, handle down, between a stock shelf and small toilet on second floor. The ringing of the outside rotary gong attracted a number of people, including several policemen, but apparently no one knew why the gong was ringing until an employee happened along and immediately caused an alarm to be sent in. It is said that about fifteen minutes had elapsed before this was done.

The fire department found that three sprinklers were operating and had entirely extinguished fire. Some time elapsed before the fire department found out how to shut off the sprinklers, causing an unnecessary water damage.

In view of the publicity given automatic sprinklers in the last few years, there does not seem to be any excuse for the ignorance shown by the police and fire department of this good-sized city.

S–15476. This was an ordinary picker fire in a cotton mill. Fire was carried up through trunks to third floor but did not get into machines there, as sprinklers in trunks at second and third floors held it. This fire shows the advantage of providing heads directly over hoppers, as in this case these heads opened promptly and extinguished fire before heads in ceiling opened, which saved wetting down many belts.

S–15492. Fire originated in scrap wood and shavings in the boiler room, probably by a spark from the boiler furnace. The fire spread up rubbish chute to third floor of adjoining factory building, where it was checked before causing any damage by the eight sprinklers that opened.

S–15394. Fire started in stock of buttons and trimmings from cigarette stub thrown by employee, causing quick fire and intense heat with considerable smoke. Heads opened promptly and extinguished fire, but smoke was too thick for department to tell whether fire was out or not, so they let sprinklers operate longer than they would had they been able to get to fire. Loss of $10,126 was practically all from water and smoke.

S–15585. Fire occurred from unknown cause in stock of chemicals, including potassium nitrate, chlorate and permanganate. A sprinkler nearly overhead opened and extinguished the fire before any of the chemicals began to vaporize, which might have resulted in a serious explosion.

Open Sprinklers.

S–15473. This mill constructed plant was severely exposed by a fire in a nearby milling plant. The flames fanned by a strong wind had already cracked the glass when the outside sprinklers were turned on, and within five minutes the water had cooled the window glass despite the fact that the flames were rising above the height of the building. The outside

sprinklers were so effective that in no instance did an automatic sprinkler open within the building.

Tin-Clad Shutters.

S-15423. Four-story brick building was severely exposed by several ice houses of frame construction which were completely destroyed. Tin-clad shutters on brick building held excellently with no indication of failure in any instance. Two lights of glass were broken in windows by heat, but no sprinklers opened inside of building.

Wired Glass Windows.

S-15567. Property consisting of six-story, mill-constructed building with wired glass windows, was exposed for over an hour by fire in adjacent six-story brick building. The only damage was that caused by the firemen who entered the building and made holes in the wired glass windows through which they fought the fire successfully.

H-9638. This five-story building and basement with blind attic and concealed spaces in ceilings was occupied throughout by a department store. The walls were of brick and exterior openings were protected by approved wired glass and metal frames. Floors consisted of single boards on joisted construction, supported on unprotected steel I-beams. There were two elevator shafts in the building, one of which was trapped at each floor and the other was open from basement to roof. Stairways were not cut off.

This building was located in the very heart of the congested value district and a fire originating here might have easily been the origin of a serious conflagration. The cause of the fire is not known, but it originated on the third floor, in the millinery department, near the elevator shaft. There was a large pile of rubbish on and near the elevator which was at the third floor at time of fire, and it may be that fire originated in this waste paper and rubbish. When discovered, fire was well advanced. The wired glass windows were all shut and locked, and the firemen had great difficulty in gaining access to the fire. It was because of the fact that the windows were closed that the fire was extinguished with no greater loss, for the smoke and air were so confined that the fire was kept smothered until the firemen finally succeeded in gaining control. Originating on the third floor it swept up and down the elevator shaft to the fourth, fifth and second floors. The elevator traps on the fourth and fifth floor openings were burned completely and the shaft was left open from second floor to roof. The fire department was greatly hampered through lack of sufficient apparatus and men. Only seventeen trained firemen were available at time of fire and these were sufficient only for a single relief. There should have been not less than three reliefs on account of dense smoke and intense heat encountered. The water pressure throughout the entire fire was excellent. Four streams through from 500 to 700 feet of two and one-half inch hose

on each connection showed excellent pressure at all times. The standpipe equipment was brought into action during the later stages of the fire and is credited with being of valuable assistance.

Extent of Damage: Neither the exposed buildings nor the stock contained therein were damaged in the slightest degree. The ceilings and walls of third, fourth and fifth floors were so badly damaged that a great portion of these will have to be refinished, but the basement, first and second floors suffered but slight fire and water damage to the building itself. Damage to stock due to heat, fire and water was very large but by no means total.

Conclusions: The fact that the approved wired glass windows were all closed and locked before fire originated is, without doubt, the real reason that greater damage did not result. Practically every opening in the building was closed and in this way the fire was gradually smothered out. The fire was communicated from third to other floors by means of the freight elevator shaft. This was trapped at each floor, but the traps were completely consumed by the fire. The other floor openings were unprotected and added materially to the water damage on the lower floors. Concealed spaces in the ceilings increased the difficulty in extinguishing the fire, and the lath and plaster ceilings were severely damaged in parts.

Steam Jet.

H-9386. This fire started from unknown cause in a one-story brick joist constructed linseed oil refinery building, sixteen by thirty-two by sixteen feet high, with joisted tank platform in center, sixteen by sixteen by seven feet high. Building contained a steam jacketed steel refining tank with metal cover, four feet six inches in diameter, eight feet high, with a capacity of approximately 800 gallons. There were also four barrels in room being filled with dryer from mixer and there were eight other barrels of various grades of paint oils stored nearby. On the wooden platform in center were four steel oil refinery and mixing tanks of eighty gallons capacity with automatic conical covers having fused links. A sixty-gallon mixing tank operated by a motor was built on a small plank stand eighteen inches high. On the opposite side of room and about twenty feet from mixer was an open steel refined oil tank, eight feet in diameter and four feet high.

History of Fire: From information furnished by property owner, fire occurred just before 5 p. m., at a time when a light might have been needed. The man in charge of refining building, who was working the mixer with a dryer of prepared linseed oil and litharge and thinned with benzine, was badly burned from explosion and fire. Employees close by heard the explosion, and after taking care of the injured man, used a line of two and one-half inch hose. Steam jet was opened and it is claimed practically smothered fire. One line of hose was also used by fire department. Fire burned contents of mixer and what oil there was in four small

tanks, and also destroyed oil in the open tank. It was stated by those present that steam jet was a considerable factor in controlling the fire. It was claimed that flames shot out from all sides of building before the steam was turned on, but the effect of steam jet seemed to smother the flames at once. Hose and extinguishers completely extinguished the fire after steam jet was shut off.

Chemical Extinguishers.

S-15481. This fire occurred in a linoleum and oilcloth factory of five stories and basement, having brick walls and concrete floors. The fire started in vicinity of machine for applying varnish to linoleum, probably from static electricity. Flames enveloped machine and spread along linoleum but were confined to that room by closing the fire doors. Several sprinklers opened and helped to extinguish fire in wooden ceiling and window framing, but the varnish in machine was blazing and water was having no effect except to float varnish on floor. Several pails of sand were used by employees but it was found that the same had a tendency to float the varnish and not extinguish the same. Chemical extinguishers were then brought into play, and with the aid of twenty-six of these the fire was extinguished after having lasted nearly an hour. It is evident from an examination of the sprinkler heads the water was shut off some little time before the fire was extinguished.

S-14577. A reel of film being shown evidently became overheated from the arc light of the machine and burst into flame and fire spread to the insulation of the wires connected to the machine and an electric fan in booth. There was nothing else to burn as the booth was constructed of heavy sheet iron on angle irons and was well vented to metal flue. The fire was quickly extinguished by a two and one-half gallon chemical extinguisher. The whole affair did not last more than ten minutes and the audience did not know there was a fire.

A good example of a special hazard properly safeguarded.

Miscellaneous.

H-9655. This fire occurred in a hay and straw warehouse with brick walls, open joist floors with unprotected openings. It was apparently of incendiary origin. When the fire department arrived the employees seemed to have the fire under control and the firemen at first only brought in a small chemical line. After the fire appeared to be extinguished with the chemical line and several firemen had examined the building, smoke was detected by the foreman, and upon further investigation fire was found to be spreading rapidly along the roof joist. The fire department then brought in two one-half inch hose lines and began to fight fire from roof. Holes were cut in roof in order that the streams might be directed on the fire. These holes in the roof probably created a draft which seemed to help the fire to spread. It began to make great headway so that four additional

alarms were sounded, bringing twenty engines, a water tower and other apparatus. Building was practically totally destroyed and loss to the contents was heavy. It required several hours to completely extinguish the fire.

S–15513. Fire occurred on a floor containing books and bookcases. Six sprinklers opened and extinguished the fire. Loss due to water was considerable and would have been less if the stock had been skidded.

S–15395. This fire of unknown origin started in the cupola of a grain elevator and was entirely extinguished by the sprinklers. Since there was no watchman nor supervisory system the water continued to flow until it reached the first floor which was provided with scuppers. The water coming out of these attracted the attention of a policeman.

H–9684. This fire occurred in a storage warehouse one and one-high story, frame, open joisted construction, built on piles on the dock. Firemen were greatly handicapped by finding water cut off from all hydrants west of the lumber dock and warehouse. After considerable delay, owing to employees being ignorant of location of valves, the water was finally turned on. One steamer became stalled in the deep sand and it was forty-five minutes after arriving at scene of fire before this steamer could be put in service. Other steamers were prevented from being placed in advantageous positions because of this deep sand.

This fire emphasizes the necessity of having employees thoroughly familiar with all valves and other apparatus, and also the necessity of keeping roads and driveways in good condition so that fire apparatus will not have difficulty in passing over them.

H–9526. The loss in this property was entirely due to water from a fire in a neighboring building. The water in seeking the lowest level was conveyed by means of a tunnel into the basement of this building which was filled with a large stock of goods susceptible to water damage. These tunnels were entirely unknown to inspectors as they had been covered over until the fire. Loss $45,658.

Fire Causes.

The fires here given are selected to illustrate defects, either of construction or superintendence, in the classes of property indicated.

Gasoline or other Volatiles.

H–9362. A tailor had just received fifteen men's suits from a dry cleaning establishment, these suits having been recently cleaned by the gasoline process. An employee was told to find out if there was any fire in the heater in the dry room, and upon reporting there was none, the suits were placed in this dry room and the door to room closed. They are ordinarily left in this room for an hour or more. About fifteen minutes after the door to the dry room was closed there was a severe explosion which blew the plate glass front of the building thirty-five feet into the street, scattering fire throughout the interior. It is not known what caused the gasoline vapor to ignite.

H–9409. This garage had an underground storage tank which was being filled from inside the building, open receptacles being used. In some unknown manner the gas which had collected became ignited, and a severe explosion took place.

The presence of the fill pipe to such a tank was prohibited by the city ordinances from being located inside the building.

H–9390. A mechanic was cleaning electric self-starter on automobile with gasoline. He did not allow sufficient time for this to dry thoroughly before starting the car. The gasoline vapor ignited, resulting in a fire which totally destroyed this small private garage. Loss $6,500.

H–9587. Engine of automobile delivery truck was allowed to run while taking on gasoline in tank on truck. A leaky connection, valve or break in distribution pipe overhead allowed vapor to escape. This took fire and communicated to oil tanks near by. Fire spread and destroyed entire plant, which was a large refinery and manufactured coal oil, gasoline, lubricating oils and asphalt for roofing. Loss $150,000.

H–9520. The fire occurred while a mixture of pitch, wood oil and benzol was being boiled in a steam heated kettle. The foreman of the plant was standing near the kettle when the fumes of the benzol exploded.

The force of the explosion threw the foreman through the door, severely burning him at the same time. The contents of the kettle became ignited and fire spread to several barrels of pitch and oil. Fire was fought and practically extinguished by employees using a five-eighths inch hose stream from standpipe located in paint department.

S–15628. At 6.40 a. m. chauffeur brought a five-gallon can of gasoline into garage and proceeded to fill tank of motor truck by light of kerosene lantern. He placed lantern on seat of truck and was filling tank when gasoline in can ignited from the lantern. Chauffeur immediately jumped from truck with can and in doing so spilled can with burning gasoline on cement floor, the blazing gasoline running under automobiles near by. Chauffeur then carried can outside building and immediately pulled in public fire alarm. Four sprinklers in monitor over garage opened. Loss $1,150 to trucks.

Garages should be provided with electric lights so that there will never be any occasion for using an open light.

S–15463. Beads for automobile tires are cleaned in a tank of naphtha set on a bench and are then dipped in a tank of rubber cement near by. The naphtha tank usually contains about fifteen gallons and the cement tank about twenty gallons.

Fire was apparently caused by static electricity generated while the employee was wiping a bead taken from the naphtha tank with a cloth, and flashed to the cement tank. The naphtha tank was partly covered with a metal cover. Water from the sprinklers overflowed the cement tank and spread the burning cement over the floor. The fire was extinguished by sawdust and chemical extinguishers. The sawdust is said to have been very effective, but was not applied until the arrival of the mill fire brigade, after the burning liquid had spread over the floor.

S–15404. In this shoe factory two girls are employed to fill up little holes in the shoe tops with soft wax. On the bench a small portable gas burner is used to warm the tools; while directly under the bench is a crockery jug containing a mixture of alcohol and ether (used to clean off or polish top of shoe after wax is hard). When the girls wanted to use this mixture they dipped their brush or cloth into the jug. This particular time, after one of the girls had done so, flames suddenly shot up from the jug as high as the girl's head. She fainted and fell, but was pulled away from the flames by a workman, and was only slightly burned. A sprinkler head directly above opened and practically extinguished the fire.

S–15548. This dip tank fire was caused either from a spark thrown by emery buffing wheel ten feet distant or by a spark from a forge on floor below passing through crack in floor into the tank. Employees quickly closed the drop door to tank confining fire within the tank. A forty-gallon chemical engine was used and extinguished fire before the enclosure became heated to any extent.

S–15304. A man with an automobile truck was starting to draw gasoline from tank to fill automobile when the watchman came along and started to talk. His lighted lantern ignited the gasoline vapor. Sprinklers operated very satisfactorily but on account of top of automobile the water could not reach contents.

S–14696. An employee was cleaning some automobile parts on a table near a belt, and was applying the gasoline with a brush. It is said that the brush was brought too close to the moving belt, resulting in a spark of static electricity due to the friction, which ignited the gasoline fumes.

S–15306. Repair man was using gasoline with brush and pail for cleaning mechanism of automatic clutch on electric starting apparatus of an automobile. He disturbed a loose wire connection, causing a spark which ignited the vapor. His quick movement to avoid the fire overturned the pail which was partly filled with gasoline. This also caught fire, spreading over the floor and damaging three automobiles. The prompt opening of fifteen sprinklers prevented the spread of flames, and extinguishers were used effectively under the cars where water from the sprinklers could not reach the fire.

Fuel Oil.

H–9412. This fire, which took place in the foundry, was caused by a stream of fuel oil from broken service pipes to furnace coming in contact with open coal fire on forge, the oil supply being in an underground tank of 600 gallons capacity under air pressure at all times.

Dust Explosions.

H–9389. This fire took place in a macaroni factory and apparently started near the dough mixers around which there is always considerable flour dust in suspension and covering walls, machinery, etc. The explosion of this flour dust was evidently brought about by some unknown means, possibly from an overheated shafting, machinery or static electricity.

It was impossible to fight fire with the fire pails, which were the only inside protection, as the fire spread to roof and flashed through room so quickly as to drive out the fifteen or twenty men at work, two of whom, located nearest the fire, were badly burned and are still in the hospital unable to tell just what happened. The fire, fed by an accumulation of flour dust on trusses and walls, soon enveloped the roof of the one-story portion, breaking through and spreading on all sides to surrounding buildings through unprotected windows in walls. The fire was fought by three fire boats and about twelve steamers and was extinguished after having caused considerable damage.

In properties of this kind which are always susceptible to dust explosions unusual care should be taken to guard against such hazards.

S–15531. A small fire was discovered in dust on iron I-beam in boiler room by watchman. A hose line was turned on it, but apparently drove fire through hole around I-beam into brick and iron shavings vault. This caused a dust explosion in the bin which blew off roof and a large section of brick wall was thrown down. Sprinkler pipes were broken off in the bin and fire in shavings was extinguished by hose lines. Direct damage by fire was very slight.

S–15409. Fire was caused by an employee entering the shavings house with lighted lantern, causing explosion of dust. Roof was blown off the building which was a one-story brick structure ten feet by twelve feet with gravel roof.

Acetylene Gas.

H–9597. A box car containing forty tanks of absorbed acetylene gas for the use of locomotive head lights arrived in the yard in the morning. This car had been moved about the yard several times in different locations, and just before the fire that afternoon a brakeman, who was walking along the tracks for the purpose of hooking up the air brake hose of cars on this track, heard a hissing noise which he took to be air from the engine. Thinking that the engineer had let the air in by mistake, the brakeman went back to the tender of the engine. He found this was not the case and retraced his steps to his former position. He then noticed that the hissing came from the box car but saw no evidence of fire at that time. The brakeman then ran back and notified the engineer and while both were investigating, the car burst into flames with heavy explosions. It was stated that there was a series of explosions which followed the first outburst and that streams of light shot through the air having much the appearance of meteors. The gas tanks shot in different directions, their course being easily traced by the lighted gas that trailed behind them. The terrific force with which these missiles traveled through the air was indicated by one which shot through both sides of an empty coal car fifty feet away, and then continuing its course across the main tracks of the railroad entered another coal car with high sides, on the farther track, and landed in the vacant lot 500 feet from where it started.

These acetylene tanks were made of copper, three feet long and twelve inches in diameter, the shell being three-sixteenths inch and the head seven-thirty-seconds inch thick. The longitudinal seam of the tanks was riveted but the top and bottom seams appeared to be brazed with hard solder. One label plate showed that the tank contained 225 cubic feet of gas at 150 pounds pressure. These tanks are similar to the well known Prest-o-Lite tanks and were filled in practically the same manner, that is, with asbestos and acetone, which absorbs the acetylene gas. They are provided with valves having a protecting clamp, and with fusible plugs which will release in case of fire.

Twelve of the tanks were whole with the fusible plug blown. Eight of these were open and showed a heavy deposit of carbon on the interior.

One was split open its entire length, which gave evidence of great heat, there being no carbon present. Several of the tanks had burst in one or two places.

The cause of this fire was not determined. From the testimony of the brakeman, who first noticed the hissing noise, it would seem that one of the valves had in some way become broken, liberating the gas which may have become ignited from his lantern when he started back towards the engine.

Construction.

H–9435. The buildings involved in this fire were seven out of a row of ten frame dwellings, each three stories, basement and attic in height and 1,000 square feet in area. The division between houses consisted of a cinder concrete filling between the studding. It was very soft and apparently barely enough cement had been used to bind together the other materials. The spread of this fire again demonstrated the unreliability of a filling of fireproof material between wood members as a barrier to the spread of fire. Such construction is of little value as a fire stop and is effective as a fire retardant only when unusual care is taken to fill all spaces completely with approved fireproof material.

S–15462. Fire evidently originated in first floor of the middle building and spread through the holes and cracks in the thin, single board floor into the floor above. Fire also spread through belt hole at engine into first floor of north building, resulting in considerable loss.

Unprotected openings are serious defects and should be guarded against.

H–9669. This fire took place in a four-story brick building of heavy plank board timbers with wooden girders extending into the wall, self-releasing but projecting so far into wall as to touch or practically touch the timbers of adjoining building opposite them. Inspection showed that in a number of places the ends of beams and girders in the two buildings where timbers were exactly opposite each other, were either not separated by masonry or were very poorly separated, so that at these locations fire rapidly made its way through the wall.

H–9477. Building was brick construction with single two-inch plank floors and large open elevator shaft extending from first to third floor. A brick wall with unprotected openings divided the two-story section from the three-story section. Had the elevator shaft been enclosed and properly trapped and the openings in the division walls been protected, the damage would have been limited to about one fifth the present loss.

Lint.

H–9531. Pile of lint on wood floor became ignited probably by spark on shovel used to transfer material to burning furnace.

H–9480. Fire in laundry was due to lint on machinery catching fire from kerosene oil torch used by employee.

Chemicals.

S–15457. Fire started among a few small wooden trays containing dry printers' colors (blue bronze). These trays were placed directly over the steam pipes in a metal lined dry room to dry colors. Apparently the trays were placed too close to the steam pipes and caught fire. One sprinkler head opened and practically extinguished fire.

S–15517. This fire appeared in some Prussian blue which had been ground ten days previously. Eight barrels of the material were standing in a row. Fire which apparently originated in one end barrel was communicated to others by sparks which fell on the paper covers.

Fires in various dry colors in this class are not unknown, but have usually been thought due to sparks in grinding and manifest themselves within twelve hours after the grinding. The fact that this fire broke out ten days afterwards was difficult to understand, as there is no reason for spontaneous ignition, from a chemical point of view, in this material. The substance will ignite from a burning match but burns slowly and without flame. The fire in several barrels burned holes through the staves near the bottom where it had burned through the contents without consuming any considerable quantity of Prussian blue.

Electrical.

H–9686. The spring on a motor starting rheostat had been removed in order that lever could be left on an intermediate point to make motor run slower. The lever had not been moved to "off" position so that when main switch was closed a heavy current passed through the motor, causing an arc which set fire to woodwork near by.

S–15634. Fire was caused by a high tension electric wire (6,600 volts) which passed over roof of building, becoming broken and dropping on roof where it started a fire.

Wires of this nature should be supported in a manner which would prevent such a possibility.

S–15475. The auto-starter controlling a 75 H. P., 440-volt, 3-phase motor was left in the starting position, which resulted in the burning out of the coils. Fire was communicated to the wood side of the building and extended up to the roof. Within five minutes after the fire started, two lines of large hose were brought into use and the fire extinguished. The water had been cut off the sprinklers for the winter so they did not aid in extinguishing the fire.

H–9535. An electric pressing iron of five amperes capacity was left with the current connected and burned a hole through table. This iron is designed with a stand attached to its end and forming a part of the iron, but

was not used as intended owing to the inconvenience of frequently placing the iron in this position. A small metal cylinder about one inch high was used instead.

S-15488. When the workman hung up his freight hook on the iron support holding a 550-volt compensator which controlled the motors driving the pickers, in some way the hook short circuited the leads from the compensator to the circuit breaker directly above on the post to which it was secured, and a short circuit took place across the terminals. Sparks from this set fire to the cotton, and it quickly flashed over the nine bales on the floor beneath.

H-9484. The fire in this cotton seed oil mill was caused by an incandescent electric light globe located about two feet above a linter roll, bursting and dropping hot glass and molten filament on the cotton roll and setting fire to same. The cause of the lamp bursting was due to the negligence of the engineer who started up the electric generator that supplied current for the plant and left the engine room for half an hour. The voltage ran up far above normal and caused many lights to burn out and others to burst.

Incandescent lights in such properties should be protected by a heavy outer globe and wire guard.

Matches.

H-9673. The matches in the pocket of superintendent caught fire when he leaned against a hot pipe. He pulled them out of his pocket and they fell into some alcohol which had just been drawn. Loss $13,824.

H-9576. One of the employees engaged on the upper floor struck a match to procure light in a dark corner and, as he stated, a piece of the match head flew among some paper bags. In attempting to extinguish the fire it spread and enveloped him in smoke, rendering him helpless until he was rescued by the firemen, who were called. Loss $10,532.

Ovens.

S-15544. Two long brick drying ovens with open ends were used to slowly dry enamel ware. The ovens were heated by gas flames inside and at the floor. The floor of the building near these ovens was brick laid on cinders. This fire seems to have been caused by the constant heat setting fire to the cinders beneath this brick floor inside one of the ovens, for after the fire it was discovered that the brick floor had settled inside the oven and a wood column was burned off beneath the brick floor and was badly charred along its entire length.

H-9463. This fire in a frame constructed building occupied as a bakery was caused by a brick dropping out of bottom of oven, which let fire down into rubbish.

Pressing Irons.

S-15624. An employee was doing some pressing with a gas heated iron and left it upon a wooden table when called to wait on a customer. Then as it was closing time he left, forgetting the iron. Fire was discovered two hours later by sprinkler alarm.

S-15468. An employee left the flame burning in a gas pressing iron on leaving work at 6 p. m. The metal stand was slowly heated and this communicated heat to the wooden cloth-covered pressing table which became ignited about 8.30 p. m. One sprinkler opened and kept the fire in check until the arrival of fire department.

Miscellaneous.

H-9549. A self-propelled steam fire engine, responding to an alarm, ignited an awning by sparks from the smokestack. This engine is not provided with a spark arrester, and often live coals are shot a considerable distance into the air and have several times caused awning fires.

H-9541. Fire in planing mill is supposed to have been caused by spark from cut-off saw falling into sawdust collector.

H-9436. During the exhibition of a moving picture reel the film in some way became jammed in the head of the picture machine. The automatic shutter had been removed, and the operator did not have sufficient presence of mind to shield the film from the beam of light, so that the film was in flames in a few seconds.

H-9367. This factory manufactures agricultural implements. Some paint had been spilled on the floor, and the owner used some hot ashes from the boiler to dry the spot, causing fire. Loss, $6,246.

H-9419. Two kerosene oil engines were located close to the wooden wall of the building. This became ignited from red hot mufflers and exhaust pipes, causing a loss of $7,000.

S-15510. A back fire of gasolene gas from one of the forges, when the power was suddenly shut off, started this fire, a gasoline gas system being used for heating forges and furnishing light. System was apparently well installed. Gas passed through safety blow-off pots and then into property. Each forge and lighting system was equipped with fire screens. At the time of fire the stop at forge failed to hold and fire worked back to safety pot, blowing into bottom and setting fire to wood enclosure, finally working through window into mill, setting off two sprinklers. Had there been no enclosure around safety blow-off pot, it is not likely there would have been a fire.

S-15280. This fire was caused by paper-backed buttons which had been soaked in a solution of linseed oil and turpentine becoming ignited while being dried in steam oven which was used to harden them. It is

probable that had this oven been properly vented, allowing fumes to escape, the fire would not have occurred.

H–9499. Fire in this paper box factory was probably caused from defective gas heated stripping machine, the burners of which were unprotected, and ignited accumulation of combustible material below same.

Burners of glue pots and gas heated stripping machines should be protected, and rubbish kept clear of same.

S–15485. The fire was caused by an operator, who was making repairs to a mule, overturning the candle which he used for light. Fire spread into the carriage of the machine and along the cop yarn on the carriage and into the creel. One sprinkler opened, and with the aid of one line of small hose and fire pails, the fire was extinguished in about twenty minutes.

S–15572. Fire was caused by small heating boiler igniting wooden floor. This boiler was set on one layer of brick, and it is thought that fire dropped down from boiler through bricks and smoldered in the wood flooring all night.

S–15430. Fire was caused by hot bearing at blower igniting oily sawdust inside of pulley. Employees used dry powder extinguishers without effect. In the meantime heat had opened one sprinkler head, which practically extinguished fire.

Property owners should purchase only approved extinguishers, thus securing a reliable article.

S–15627. The engineer was in the habit of drawing the ashes from the boilers, and piling them in a corner against the building. A window in the basement had been boarded over so that the ashes would not get into the building. The danger of this had been called to attention of engineer, but did not do any good. One evening a policeman noticed smoke, and on investigation found the boards over the window on fire. The fire department extinguished the fire with chemicals.

Annual Summary.

Statistics of Fires in Properties Having Automatic Sprinkler Protection.

NOTE.—These tabulations are made at the close of each fiscal year, with the object of furnishing a basis upon which the virtue of the automatic sprinkler as an extinguishing agent can be estimated.

Section I is devoted to fires in which the behavior of sprinklers was, for the reasons given, unsatisfactory.

Section II is a statistical record of all reports of sprinkler fires in the files of Association upon which the information obtained is sufficiently complete for statistical purposes.

In each table the results of the current year ending April, 1, 1914, are given, and these are compared to the results of the total seventeen-year record ending at this time.

An examination of the data in this annual summary does not bring out any pronounced changes from that given in former years. The fires classed as unsatisfactory continue to be due for the most part to lack of supervision of the sprinkler equipment. The largest single cause of such unsatisfactory fires is again found to be that of having the water shut off. However, it is of interest to note that the percentage of unsatisfactory fires is slowly decreasing, which indicates that the automatic sprinkler equipment is generally receiving more careful attention. The figure of 3.62 per cent this year contrasts very favorably with that of 4.1 per cent for last year and a seventeen-year average of 4.80 per cent.

One of the most remarkable showings made during the last year was that of the cotton mills. Our record contains 275 fires in this class of property, and in no instance did the sprinklers fail to either extinguish or hold the fire in check. This is a fine example of what fire protection engineering is able to accomplish in one of the most hazardous of industries.

The percentage of fires which were extinguished by the sprinklers is 62.82 per cent, and of those held in check 32.38 per cent, making a total of 95.2 per cent of all fires in which the operation of the automatic sprinklers was satisfactory. The actual decrease in the ratio of unsatisfactory fires for this year is approximately 11.6 per cent.

The number of fires in which only one sprinkler opened increased from 30.9 per cent for last year to 33.9 per cent this year, which is reflected in the seventeen-year record by an increase of from 30.2 per cent to 30.5 per cent. It is interesting to find that throughout the record given in Table No. 5 there is an increase in the percentage of fires extinguished by a small number of sprinklers. The value for ten sprinklers or less has increased from 81.3 per cent to 83.3 per cent, while those fires in which over one hundred have opened has decreased to 2.7 per cent. In ninety per cent of all fires, twenty heads or less will be sufficient to control them.

Certain other slight changes are worthy of note, such as the continued increase in the percentage of wet systems as compared to dry systems. The number of fires occurring in the day time continue to outnumber those at night by a large margin.

SECTION I.

Summary of Unsatisfactory Sprinkler Fires.

	1913-1914. No. of Fires.	Per Cent.	1897-1914 No. of Fires.	Per Cent.
Water shut off sprinklers	19	43.1	173	24.5
Generally defective equipment	4	9.1		
Unsprinklered portions	3	6.8	166	23.5
Defective heads	3	6.8		
Defective water supply or supplies	3	6.8	76	10.8
Sprinkler system crippled due to freezing	1	2.3	18	2.5
Slow operation of dry system or defective dry valve	..	..	15	2.1
Slow or defective operation of high test heads	1	2.3	13	1.8
Faulty building construction, concealed space, vertical openings, etc.	4	9.1	34	4.8
Obstruction to distribution	1	2.3	35	5.0
Hazard of occupancy too severe for average sprinkler equipment	1	2.3	36	5.1
Explosion crippled sprinkler system	3	6.8	28	4.0
Exposure or conflagration	..	..	61	8.6
Miscellaneous	..	..	25	3.5
Plugged heads	..	..		
Not classified	1	2.3	27	3.8
Total	44		707	

Special Classification of Fires in which Failure was Due to Water Being Shut Off Sprinklers.

	1913-1914. No. of Fires.	1897-1914 Inc. No. of Fires.
Water shut off for unknown reason, neglect or carelessness	6	70
Water shut off before fire was out or fire re-kindled	1	28
Water shut off due to accident or repairs	5	30
Water shut off to prevent freezing	4	27
Water shut off, probably incendiary	2	9
Water shut off, leaky dry system	..	3
Water shut off, miscellaneous	1	4
Water shut off, defective gate valve	..	2
Total	19	173

SECTION II.

Annual Revision of Sprinkler Fire Tables.

In the following ten tables is given a summary of fires occurring in properties equipped with sprinklers. The number of fires reported during the year was 1214, not including many in which there were no sprinklers opened. There have also been received several reports in which the data was incomplete, and these were not used in this summary.

Table No. 1.

Time of Day.

	No. of Fires. 1913-1914.	No. of Fires. 1897-1914 Inc.	Per cent of No. with Data Given. 1913-1914.	Per cent of No. with Data Given. 1897-1914 Inc.
6 a. m. to 6 p. m.	734	7444	61.2	59.1
6 p. m. to 6 a. m.	464	5143	38.8	40.9
Total with data given	1198	12587		
No data	16	303		
Total	1214	12890		

Table No. 2.

How Discovered.

	No. of Fires. 1913-1914.	No. of Fires. 1897-1914 Inc.	Per cent of No. with Data Given. 1913-1914.	Per cent of No. with Data Given. 1897-1914 Inc.
Employee	696	7669	58.0	61.5
Watchman	161	1936	13.4	15.5
Sprinkler Alarm	202	1663	16.8	13.3
Outsider	67	650	5.6	5.2
Thermostats	49	468	4.1	3.9
Automatic Pump	..	10	..	.08
Supervisory System	25	79	2.1	.52
Total with data given	1200	12475		
No data	14	415		
Total	1214	12890		

Table No. 3.

Efficiency of Alarm Service, 1913-1914.

	Satisfactory.		Failure.		Total.
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	
Watchman alone	87	89.6	10	10.4	97
Sprinkler alarm alone	131	91.9	13	9.1	144
Thermostats alone	..	..	1	100.0	1
Supervisory system alone	4	80.0	1	20.0	5

	Watchman.		Sprinkler Alarm.		Thermostat.		Supervisory.		Total.
	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	
Watchman and Sprinkler Alarm	81	46*	116	11	..	..	..	..	127
Watchman and Thermostats	..	1*	..	..	1	..	..	..	1
Sprinkler Alarm and Thermostats	..	..	38	6	38	6	..	..	44
Watchman, Sprinkler Alarm and Thermostats	3	6*	9	..	9	..	..	..	9
Sprinkler Alarm and Supervisory	..	..	19	1	..	..	19	1	20
Watchman and Supervisory	..	..	..	..	..	..	..	..	..
Watchman, Sprinkler Alarm and Supervisory	2	12*	14	..	..	..	14	..	14
Sprinkler Alarm, Thermostats and Supervisory	..	..	4	..	3	1	4	..	4

Efficiency of Alarm Service, 1897-1914, Inclusive.

	Satisfactory.		Failure.		Total.
	No. of Fires.	Per Cent.	No. of Fires.	Per Cent.	
Watchman alone	1100	90.2	118	9.8	1218
Sprinkler alarm alone	1124	92.5	89	7.5	1213
Thermostats alone	154	79.0	41	21.0	195

	Watchman.		Sprinkler Alarm.		Thermostat.		Supervisory.		Total.
	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	Satisfactory.	Failure.	
Watchman and Sprinkler Alarm	844	454*	1134	164	..	..	..	..	1298
Watchman and Thermostats	12	5*	..	..	16	1	..	..	17
Sprinkler Alarm and Thermostats	..	..	373	30	305	98	..	..	403
Watchman, Sprinkler Alarm and Thermostats	34	51*	78	7	65	20	..	..	85
Watchman and Supervisory	2	..	..	..	..	..	2	..	2
Sprinkler Alarm and Supervisory	..	..	78	3	..	..	78	3	81
Watchman, Sprinkler Alarm and Supervisory	29	26*	55	..	..	..	55	..	55
Sprinkler Alarm, Thermostats and Supervisory	..	..	13	..	10	3	13	..	13

*These include fires where sprinkler alarm or thermostats notified the watchman.

Note.— These tables do not include fires where alarm service does or does not operate promptly if fire is at once discovered by employee, the alarm service having no bearing on such fires one way or the other.

Table No. 4.

Number of Sprinklers Operating.

No. of Sprinklers Operating	No. of Fires. 1913-1914.	No. of Fires. 1897-1914 Inc.	Per Cent. of Whole. 1913-1914.	Per Cent. of Whole. 1897-1914 Inc.
1	401	4374	33.9	30.5
2	215	2310	18.2	16.1
3	98	1463	8.3	10.2
4	97	1062	8.2	7.4
5	45	688	3.8	4.8
6	50	589	4.2	4.1
7	33	390	2.8	2.7
8	35	383	3.0	2.7
9	22	253	1.85	1.8
10	16	233	1.4	1.6
11	13	200	1.1	1.4
12	20	212	1.7	1.5
13	5	115	0.4	0.8
14	16	144	1.4	1.0
15	9	113	0.8	0.8
16 to 20	23	389	1.9	2.7
21 to 25	22	258	1.85	1.8
26 to 30	12	185	1.0	1.3
31 to 35	11	107	0.9	0.7
36 to 40	5	92	0.4	0.6
41 to 50	9	131	0.8	0.9
51 to 75	14	182	1.2	1.3
76 to 100	4	89	0.3	0.6
Over 100	7	391	0.6	2.7
Total with data given	1182	14353		
Water shut off sprinklers	19	136		
No data	13	225		
Total	1214	14714		

Table No. 5.

Number of Sprinklers Operating.

No. of Sprinklers Operating	No. of Fires. 1897-1914 Inc.	Per Cent. of Whole 1897-1914 Inc.
1	4374	30.5
2 or less	6684	46.6
3 or less	8147	56.8
4 or less	9209	64.2
5 or less	9897	69.0
6 or less	10486	73.1
7 or less	10876	75.8
8 or less	11259	78.5
9 or less	11512	80.3
10 or less	11745	81.9
11 or less	11945	83.3
12 or less	12157	84.8

Table No. 5—Continued.

Number of Sprinklers Operating.

No. of Sprinklers Operating	No. of Fires. 1897-1913 Inc.	Per Cent. of Whole 1897-1913 Inc.
13 or less	12272	85.6
14 or less	12416	86.6
15 or less	12529	87.4
20 or less	12918	90.1
25 or less	13176	91.9
30 or less	13361	93.2
35 or less	13468	93.9
40 or less	13560	94.5
50 or less	13691	95.4
75 or less	13873	96.7
100 or less	13962	97.3
Over 100	391	2.7
Total with data given	14353	
Water shut off sprinklers	136	
No data	225	
Total	14714	

Table No. 6.

Sprinklers Opened on Wet or Dry Systems.

	No. of Fires. 1913-1914.	No. of Fires. 1897-1914 Inc.	Per Cent. of No. with Data Given. 1913-1914.	Per Cent. of No. with Data Given. 1897-1914 Inc.
Wet system	1034	10022	86.7	80.3
Dry system	158	2457	13.3	19.7
Total with data given	1192	12479		
Water shut-off system	19	136		
No data	3	275		
Total	1214	12890		

Table No. 7.

Primary Water Supplies to Sprinklers Opened.

	No. of Fires. 1913-1914.	No. of Fires. 1897-1914 Inc.	Per Cent. of No. with Data Given. 1913-1914.	Per Cent. of No. with Data Given. 1897-1914 Inc.
Water Works	628	6302	52.7	50.6
Gravity Tank	284	3602	23.9	28.9
Pressure Tank	221	1841	18.5	14.8
Automatic Pump	55	712	4.65	5.70
Automatic Electric Pump	2	4	0.17	0.03
Steamer Connection	1	3	0.08	0.025
Total with data given	1191	12464		
Water shut off system	19	136		
No data	4	300		
Total	1214	12900		

Table No. 8.

Effect of Sprinklers.

	No. of Fires. 1913-1914.	No. of Fires. 1897-1914 Inc.	Per Cent. of No. with Data Given. 1913-1914.	Per Cent. of No. with Data Given. 1897-1914 Inc.
Practically or entirely extinguished fire	716	9243	58.98	62.82
Held fire in check	454	4764	37.40	32.38
Total successful	1170	14007	96.38	95.20
Unsatisfactory	44	707	3.62	4.80
Total	1214	14714		

Table No. 9.

Showing Effect of Sprinklers by Class of Occupancy.

	Extinguished Fire.		Held Fire in Check.		Total Satisfactory.		Unsatisfactory.		Total No. of Fires
	No.	%	No.	%	No.	%	No.	%	
Agricultural Implements	37	59.7	22	35.5	59	95.2	3	4.8	62
Automobile and Bicycle Factories	37	60.6	21	34.5	58	95.1	3	4.9	61
Awning Factories	3	100	..	..	3	100	..	..	3
Bag Factories	2	50	2	50	4	100	..	..	4
Bakeries	20	60.6	11	33.3	31	93.9	2	6.1	33
Basket Factories	7	100	..	..	7	100	..	..	7
Bolt, Nut and Screw Works	6	75	2	25	8	100	..	..	8
Boot and Shoe Shops	328	76.3	86	20	414	96.3	16	3.7	430
Bottling Works	1	100	..	..	1	100	..	..	1
Braiding Mills	4	80	1	20	5	100	..	..	5
Breweries	3	75	1	25	4	100	..	..	4
Broom Factories	6	54.5	3	27.3	9	81.8	2	18.2	11
Brush Factories	6	75	2	25	8	100	..	..	8
Button Manufactories	4	80	1	20	5	100	..	..	5
Candle Factories	4	66.7	2	33.3	6	100	..	..	6
Candy Factories	32	69.6	13	28.3	45	97.9	1	2.1	46
Canning Works	6	75	1	12.5	7	87.5	1	12.5	8
Car Houses	16	43.2	16	43.2	32	86.4	5	13.6	37
Car Works	47	66.2	22	31.0	69	97.2	2	2.8	71
Carpet Mills	94	58	59	36.4	153	94.4	9	5.6	162
Carriage Factories	65	65	28	28	93	93	7	7	100
Celluloid (Pyroxylin Plastic)	58	63	20	21.7	78	84.7	14	15.3	92
Cement and Plaster Works	2	66.7	..	..	2	66.7	1	33.3	3
Cereal Mills	20	62.5	8	25	28	87.5	4	12.5	32
Chemical and White Lead	28	57.2	19	38.9	47	96.1	2	3.9	49
Clothing Factories	213	75.3	65	22.9	278	98.2	5	1.8	283
Coffee and Spice Mills	29	72.5	11	27.5	40	100	..	..	40
Coffin Factories	22	75.8	6	20.7	28	96.5	1	3.5	29
Cold Storage Plants	2	50	2	50	4	100	..	..	4
Cooperage Plants	36	52.9	24	35.3	60	88.2	8	11.8	68
Cordage Works	166	67.5	71	28.8	237	96.3	9	3.7	246
Cork Factories	3	37.5	3	37.5	6	75	2	25	8
Corset Factories	2	40	2	40	4	80	1	20	5
Cotton Ginnery	9	69.2	4	30.8	13	100	..	..	13
Cotton Mills	2438	57.9	1673	39.7	4111	97.6	99	2.4	4210
Cotton Warehouses	69	43.4	74	46.5	143	89.9	16	10.1	159
Cotton Seed Oil Mills	29	51.8	18	32.1	47	83.9	9	16.1	56
Cutlery and Hardware	5	55.6	3	33.3	8	88.9	1	11.1	9
Department Stores	217	79.5	46	16.8	263	96.3	10	3.7	273

Table No. 9—Continued.

	Extinguished Fire.		Held Fire in Check.		Total Satisfactory.		Unsatisfactory.		Total No. of Fires.
	No.	%	No.	%	No.	%	No.	%	
Distilleries	4	80	1	20	5	100	..	..	5
Drug Houses	86	79.6	18	16.7	104	96.3	4	3.7	108
Dry Cleaning Establishments	2	66.7	1	33.3	3	100	..	..	3
Dyeing and Bleaching	70	46.6	72	48	142	94.6	8	5.4	150
Electrical Appliances	70	75.2	20	21.5	90	96.7	3	3.3	93
Electric Light and Power Plants	2	50	1	25	3	75	1	25	4
Elevators, Grain	14	35	13	32.5	27	67.5	13	32.5	40
Excelsior Factories	12	80	2	13.3	14	93.3	1	6.7	15
Fertilizer Plants	13	59.1	7	31.8	20	90.9	2	9.1	22
Flax and Linen Mills	12	38.7	19	61.3	31	100	..	..	31
Flour and Grist Mills	27	51	20	37.7	47	88.7	6	11.3	53
Forge and Smithy	9	75	3	25	12	100	..	..	12
Foundries	70	51.8	59	43.7	129	95.5	6	4.5	135
Furniture Factories	273	64.1	115	27	388	91.1	38	8.9	426
Garages	15	62.5	9	37.5	24	100	..	..	24
Garbage Reduction Plants	1	33.4	1	33.3	2	66.7	1	33.3	3
Gas Plants	1	100	..	..	1	100	..	..	1
Glass Works	25	67.6	9	24.3	34	91.9	3	8.1	37
Glove Factories	5	100	..	..	5	100	..	..	5
Glue Factories	2	40	1	20	3	60	2	40	5
Harness and Fancy Leather	31	79.5	8	20.5	39	100	..	..	39
Hat, Fur	27	71	7	18.4	34	89.4	4	10.6	38
Hat, Straw	4	44.4	5	55.6	9	100	..	..	9
Hatters Fur Manufacturing	4	50	4	50	8	100	..	..	8
Ice Plants	1	100	..	..	1	100	..	..	1
Incandescent Lamp Factories	9	69.1	4	30.9	13	100	..	..	13
Insulated Wire Factories	19	63.3	11	36.7	30	100	..	..	30
Jewelry Shops	69	85.2	8	9.9	77	95.1	4	4.9	81
Junk Shops	4	80	1	20	5	100	..	..	5
Knitting Mills, Cop Yarn	30	58.8	16	31.4	46	90.2	5	9.8	51
Knitting Mills, Full Process	330	64.2	162	31.5	492	95.7	22	4.3	514
Laundries	15	53.5	11	39.3	26	92.8	2	7.2	28
Lead Pencil Factories	10	76.9	3	23.1	13	100	..	..	13
Linseed Oil Works	9	75	3	25	12	100	..	..	12
Machine Shops	112	57.2	72	36.7	184	93.9	12	6.1	196
Match Factories	37	72.6	10	19.6	47	92.2	4	7.8	51
Mattress Factories	136	74.3	45	24.6	181	98.9	2	1.1	183
Mercantile	380	77.8	95	19.4	475	97.2	13	2.8	488
Metal Reduction Works	3	75	1	25	4	100	..	..	4
Metal Workers	318	61.1	174	33.5	492	94.6	28	5.4	520
Miscellaneous	139	67.1	57	27.5	196	94.6	11	5.4	207
Morocco Leather Shops	4	26.7	8	53.3	12	80	3	20	15
Motion Picture Theatres	4	57.2	3	42.8	7	100	..	..	7
Musical Instrument Factories	65	69.1	26	27.6	91	96.7	3	3.3	94
Oil Clothing Factories	6	66.7	3	33.3	9	100	..	..	9
Oilcloth and Linoleum Works	19	29.2	32	49.3	51	78.5	14	21.5	65
Oil Refineries	3	42.8	4	57.2	7	100	..	..	7
Packing House and Slaughter	25	69.5	10	27.8	35	97.3	1	2.7	36
Paint and Color Works	88	72.6	30	24.8	118	97.4	3	2.6	121
Paper Box and Papeterie	61	73.5	21	25.3	82	98.8	1	1.2	83
Paper Mills	166	47.5	144	41.2	310	88.7	40	11.3	350
Patent Leather Works	5	45.4	5	45.4	10	90.8	1	9.2	11
Picture Frame Factories	23	60.5	11	29	34	89.5	4	10.5	38
Plumbers' Supplies	9	75	3	25	12	100	..	..	12
Potteries	25	59.5	15	35.7	40	95.2	2	4.8	42
Printing and Lithographing	237	78	54	17.8	291	95.8	13	4.2	304
Pulp, Miscellaneous	5	29.4	9	52.8	14	82.2	3	17.8	17
Pulp, Soda	1	20	1	20	2	40	3	60	5
Pulp, Sulphite	12	41.3	11	37.9	23	79.2	6	20.8	29

Table No. 9—Continued.

	Extinguished Fire.		Held Fire in Check.		Total Satisfactory.		Unsatisfactory.		Total No. of Fires.
	No.	%	No.	%	No.	%	No.	%	
Restaurants	6	100	..	..	6	100	..	..	6
Rice Mills	..	..	1	100	1	100	..	..	1
Rolling, Wire and Tube Works	13	46.4	14	50	27	96.4	1	3.6	28
Roofing Works	8	42.1	10	52.6	18	94.7	1	5.3	19
Rubber Cloth Factories	8	53.3	7	46.7	15	100	..	..	15
Rubber Reclaiming Works	3	42.8	3	42.8	6	85.6	1	14.4	7
Rubber Works	57	48.3	55	46.6	112	94.9	6	5.1	118
Saw and Planing Mills	54	42.2	42	32.8	96	75.0	32	25	128
Shirt Factories	26	81.3	6	18.7	32	100	..	..	32
Shoddy Mills	88	62.4	41	29.1	129	91.5	12	8.5	141
Silk Mills	24	63.2	11	28.9	35	92.1	3	7.9	38
Skin Mills	2	66.7	1	33.3	3	100	..	..	3
Soap Manufacturing	15	78.9	3	15.8	18	94.7	1	5.3	19
Stamping and Sheet Metal Works	21	53.8	13	33.3	34	87.1	5	12.9	39
Starch and Glucose Mills	8	50	3	18.7	11	68.7	5	31.3	16
Sticky Fly Paper Factories	3	75	1	25	4	100	..	..	4
Sugar Refineries	9	69.2	4	30.8	13	100	..	..	13
Tanneries	17	42.5	18	45	35	87.5	5	12.5	40
Tenant Manufacturing	265	71.8	89	24.1	354	95.9	15	4.1	369
Theatres	22	78.6	5	17.8	27	96.4	1	3.6	28
Tobacco Factories	29	64.5	15	33.3	44	97.8	1	2.2	45
Trunk Factories	4	66.7	2	33.3	6	100	..	..	6
Varnish Works	3	75	..	..	3	75	1	25	4
Wall Paper Factories	7	70	1	10	8	80	2	20	10
Warehouses	79	67.5	33	28.2	112	95.7	5	4.3	117
Waste and Batting Mills	149	69.3	59	27.4	208	96.7	7	3.3	215
Waste Paper and Rag Shops	17	68	8	32	25	100	..	..	25
Weaving Mills	60	58.2	40	38.8	100	97	3	3	103
Whip Factories	3	75	1	25	4	100	..	..	4
Window Shade Factories	7	87.5	..	..	7	87.5	1	12.5	8
Woodworkers, Class A*	79	51.2	53	34.4	132	85.6	22	14.4	154
Woodworkers, Class B*	73	47.3	65	42.2	138	89.5	16	10.5	154
Woodworkers, Class C*	79	59.7	45	34.1	124	93.8	8	6.2	132
Woodworkers, Class D*	54	55.7	30	30.9	84	86.6	13	13.4	97
Woodworkers, Class E*	46	55.4	32	38.6	78	94	5	6	83
Woodworkers, Class F*	19	61.3	9	29	28	90.3	3	9.7	31
Woodworkers, Miscellaneous	1	50	1	50	2	100	..	..	2
Woolen Mills	610	69.8	217	24.8	827	94.6	47	5.4	874
Wool Storehouses	17	73.9	5	21.7	22	95.6	1	4.4	23
Worsted Mills	24	43.7	21	38.2	45	81.9	10	18.1	55
Total Sprinkler Fires	9243	..	4764	..	14007	..	707	..	14714

***Note.**— The Woodworkers are classed as follows:

Class A. Planing Mills; interior woodwork, builders' supplies (including veneer works).

Class B. Box Factories. (Including cigar boxes.)

Class C. Miscellaneous Woodworkers. Steam power tenant woodworkers (also woodworkers where there is a lack of detailed information as to class).

Class D. Sash, Door and Blind Factories.

Class E. Hard Wood Turning. (Wheels, pipes, novelties, bobbins, spools, etc., last and wood heel factories.)

Class F. Pails and Woodenware. (Plates, wooden bowls, tubs, etc.)

Table No. 10.

Classification of Unsatisfactory Sprinkler Fires by Occupancies.

	Water shut off sprinklers.	Gen. defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed space, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Explosion crippled sprinkler system.	Exposure or conflagration.	Miscellaneous.	Not classified.	Total.
Agricultural Implements.	2	..	..	..	..	..	..	..	1	..	..	..	..	3
Automobile and Bicycle..	1	..	..	..	..	..	..	1	..	..	1	..	..	3
Bakeries	..	1	..	..	..	..	..	..	..	..	..	1	..	2
Boot and Shoe Shops	3	2	2	..	..	1	..	..	..	2	5	..	1	16
Broom Factories	2	..	..	..	..	..	..	..	..	..	..	..	..	2
Candy Factories	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Canning Works.....	..	..	..	..	..	..	..	..	..	..	1	..	..	1
Car Houses.....	1	1	1	..	1	..	..	1	..	..	..	..	..	5
Car Works.....	..	1	..	..	..	..	..	1	..	..	..	..	..	2
Carpet Mills.....	4	1	3	..	..	..	..	1	..	..	..	..	..	9
Carriage Factories	..	1	2	..	1	..	..	1	..	..	2	..	..	7
Celluloid (Pyroxylin) ...	..	..	1	1	1	..	1	..	7	2	1	..	..	14
Cement and Plaster Works	..	..	..	..	1	..	..	..	..	..	..	..	..	1
Cereal Mills.....	..	2	1	..	..	..	..	..	..	1	..	..	..	4
Chemical and White Lead.	1	..	..	..	..	..	..	..	..	1	..	..	..	2
Clothing Factories.....	2	..	1	..	..	..	1	1	..	..	..	..	..	5
Coffin Factories.....	..	..	..	1	..	..	..	..	..	..	..	..	..	1
Cooperage Plants.....	1	3	..	..	..	1	..	2	..	..	1	..	..	8
Cordage Works.....	2	3	1	..	..	..	..	2	..	..	..	..	1	9
Cork Factories.....	1	..	..	..	..	..	..	..	..	1	..	..	..	2
Cotton Mills.....	19	11	6	..	..	1	4	1	..	..	..	2	4	48
Cotton Warehouses	8	..	2	..	..	..	1	3	1	..	..	1	..	16
Cotton Seed Oil Mills	1	3	2	..	..	..	..	..	..	..	..	2	1	9
Cutlery and Hardware ...	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Department Stores.....	3	3	..	..	..	..	..	1	..	..	2	..	1	10
Drug Houses	..	..	..	..	..	..	..	..	..	..	3	1	..	4
Dyeing and Bleaching....	3	1	1	..	..	1	..	..	..	..	1	..	1	8
Electrical Appliances	1	..	1	..	..	..	..	..	..	..	..	..	1	3
Electric Light and Power Plants.....	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Elevators, Grain.....	..	3	3	..	1	..	1	..	1	1	2	..	1	13
Excelsior Factories	..	..	1	..	..	..	..	..	..	..	..	..	..	1
Fertilizer Plants.....	1	..	..	..	1	..	..	..	..	..	..	..	..	2
Flour and Grist Mills	..	1	..	..	..	..	1	..	..	2	2	..	..	6
Foundries.....	4	1	1	..	..	..	..	..	..	..	..	..	..	6
Furniture Factories.....	6	12	2	3	..	..	2	5	6	..	2	..	..	38
Glass Works.....	1	..	..	..	..	..	..	..	..	..	..	..	2	3
Glue Factories.....	1	..	..	..	..	..	..	..	1	..	..	..	..	2
Hat, Fur	1	1	1	..	1	..	..	..	..	..	..	..	..	4
Jewelry Shops.....	2	1	..	1	..	..	..	..	..	..	..	..	..	4
Knitting, Cop Yarn.....	..	1	3	..	..	..	..	..	..	1	..	..	..	5
Knitting, Full Process ...	6	8	5	1	1	..	..	..	..	1	..	..	..	22
Laundries.....	1	..	..	..	..	..	..	1	..	..	..	..	..	2
Machine Shops.....	8	3	..	..	..	..	..	..	1	..	..	1	..	12
Match Factories	2	..	..	..	..	..	..	..	1	..	..	1	..	4
Mattress Factories.....	1	1	..	..	..	..	..	..	..	..	..	..	..	2
Mercantile	6	2	..	1	..	..	..	..	..	..	4	..	..	13
Metal Workers.....	11	9	2	..	..	..	..	..	..	1	2	1	2	28
Miscellaneous.....	2	2	1	..	1	..	2	..	1	..	3	1	..	13
Morocco Leather Shops ..	..	2	..	..	..	..	1	..	..	..	..	..	..	3

Table No. 10—Continued.

	Water shut off sprinklers.	Gen. defective equipment and unsprinklered portions.	Defective water supply or supplies.	Sprinkler system crippled due to freezing.	Slow operation of dry system or defective dry valve.	Slow or defective operation of high test heads.	Faulty building construction, concealed space, vertical openings.	Obstruction to distribution.	Hazard of occupancy too severe for average sprinkler equipment.	Explosion crippled sprinkler system.	Exposure or conflagration.	Miscellaneous.	Not classified.	Total.
Musical Instrument Factories	..	2	..	..	..	..	..	..	..	..	1	..	..	3
Oilcloth and Linoleum Works	..	2	..	..	..	..	1	..	11	..	..	..	..	14
Packing House and Slaughter	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Paint and Color Works	1	..	1	..	..	..	1	..	..	..	..	..	..	3
Paper Box and Papeterie	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Paper Mills	6	15	4	2	..	2	1	..	..	1	2	4	3	40
Patent Leather Works	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Picture Frame Factories	1	2	..	..	..	..	..	1	..	..	..	..	..	4
Potteries	..	..	..	1	..	..	..	..	..	1	..	..	..	2
Printing and Lithographing	4	4	1	..	..	..	..	..	..	..	3	1	..	13
Pulp, Miscellaneous	1	1	1	..	..	..	..	..	..	..	..	..	..	3
Pulp, Soda	2	1	..	..	..	..	..	..	..	..	..	..	..	3
Pulp, Sulphite	3	..	..	..	1	1	..	..	..	..	..	..	1	6
Rolling, Wire and Tube Works	..	..	..	..	..	..	..	..	..	..	..	..	1	1
Roofing Works	..	..	..	..	..	..	..	..	..	1	..	..	..	1
Rubber Reclaiming Works	..	..	..	..	..	..	1	..	..	..	..	..	..	1
Rubber Works	2	..	..	1	..	..	..	..	2	1	..	..	..	6
Saw and Planing Mills	6	6	1	..	3	1	6	2	1	..	4	..	2	32
Shoddy Mills	4	1	5	..	..	2	..	..	..	..	..	..	..	12
Silk Mills	1	1	..	..	..	..	..	..	..	1	..	..	..	3
Soap Manufacturing	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Stamping and Sheet Metal Works	..	2	1	..	1	..	..	..	..	..	1	..	..	5
Starch and Glucose Mills	..	..	..	..	..	..	..	..	1	4	..	..	..	5
Tanneries	1	..	..	2	..	..	..	..	..	..	1	..	1	5
Tenant Manufacturing	3	3	2	..	..	..	1	..	..	..	5	..	1	15
Theatres	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Tobacco Factories	1	..	..	..	..	..	..	..	..	..	..	..	..	1
Varnish Works	..	..	..	..	..	..	..	..	1	..	..	..	..	1
Wall Paper Factories	..	..	1	..	..	..	..	..	..	..	1	..	..	2
Warehouses	3	2	..	..	..	..	..	..	..	..	..	..	..	5
Waste and Batting Mills	..	3	1	..	..	1	..	1	..	..	..	1	.	7
Weaving Mills	1	..	1	1	..	..	..	..	..	..	..	..	..	3
Window Shade Factories	..	..	..	..	..	..	..	..	1	..	..	..	..	1
Woodworkers, Class A*	5	7	..	..	..	..	..	5	..	2	3	..	..	22
Woodworkers, Class B*	3	5	1	..	..	..	1	1	..	2	2	1	..	16
Woodworkers, Class C*	2	3	1	..	..	..	..	2	..	..	..	..	..	8
Woodworkers, Class D*	1	5	..	1	..	..	..	..	..	1	3	2	..	13
Woodworkers, Class E*	2	..	..	..	1	..	2	..	..	..	..	..	..	5
Woodworkers, Class F*	2	..	..	..	..	..	1	..	..	..	..	..	..	3
Woolen Mills	6	14	10	1	..	2	3	..	..	..	3	4	4	47
Wool Storehouses	..	1	..	..	..	..	..	..	..	..	..	..	..	1
Worsted Mills	2	1	2	1	..	..	..	..	..	..	..	2	2	10
Total Unsatisfactory Fires	173	165	76	18	15	13	33	34	36	28	61	25	30	707

*See detailed classification of woodworkers as given in note under Table No. 9.

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Standard Rules and Requirements

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